THE SIMON & SCHUSTER GUIDE TO

COMPUTER PERIPHERALS

COMPLETE PRODUCT EVALUATIONS FOR:

● PRINTERS ● PLOTTERS ● MONITORS ● TERMINALS
● KEYBOARDS ● MODEMS AND MUCH MORE . . .

LINDA GAIL CHRISTI

The Simon & Schuster GUIDE TO COMPUTER PERIPHERALS

by Linda Gail Christie

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Preface

With so many different products on the market, finding the right personal computer peripherals can be confusing. Generally, you've got to look at dozens of magazines and talk to salespeople and friends just to make one purchase.

This easy-to-use guide will give you a lot of information in one place about all kinds of add-on devices: printers, monitors, terminals, keyboards, modems, auxiliary memory, power protectors, light pens, digital tablets, joysticks, mice, buffers, environmental controllers, voice recognition devices, and music and voice synthesizers—but it doesn't attempt to cover computer-specific items such as boards and local area networks. (All reviewed products can be found in local computer stores.)

The author and her staff personally used and reviewed over 100 peripherals. The reviews appear in alphabetical order after the appropriate chapter. Each product is rated for its performance, ease of use, and application. The author also comments on and rates the documentation for both novices and hackers. Over 75 pictures illustrate the products.

Chapter 1, Tips for Buying a Printer, provides a checklist for rating your needs for a letter-quality printer, dot-matrix printer, color printer, and plotter. Printer terminology and printing specifications are deciphered so you'll understand what you're buying.

Chapter 2, Monitors, Terminals, and Keyboards, provides a checklist for rating your needs for a television, monochrome monitor, composite color monitor, RGB color monitor, keyboard, and terminal. The pros and cons of each type of device guide you to the best buy.

Chapter 3, Modems, provides a checklist for rating your needs for

a modem. Telecommunication terms are defined to help you sort out communication modes, baud rates, and interfaces.

Chapter 4, The Expanding World of Mass Storage, identifies the key differences among tape, stringy floppy, floppy disk, hard disk, streaming tape, and video disk technologies for mass storage. Although you may not buy a separate mass storage device, you may want to rate those provided by computer manufacturers.

Chapter 5, The World of Input Devices, explores the cursor controllers such as light pens, mice, digital tablets, joysticks, and trackballs. The unique data entry capabilities of optical cameras, bar-code readers, and voice recognition devices are also investigated. This chapter discusses how input peripherals and personal computers are freeing handicapped users from disabilities.

Chapter 6, The World of Sound Devices, takes a look at voice and music synthesis for personal computers.

Chapter 7, Making Computing Easier, reviews power protection devices, buffers, and environmental controllers. You can find out how to make both computing and your life more fun.

The appendix contains forms you can use to evaluate these devices during a shopping trip. Feel free to photocopy them for your personal use. A list of manufacturers and addresses by peripheral product(s) will help you obtain additional information.

The glossary gives quick access to new or confusing computer terms.

Chapter 1

Tips for Buying a Printer

With nearly 100 printers available for personal computers, buying a printer is at best tedious and sometimes confusing. However, most problems are manageable when broken down into smaller, understandable segments. Deciding which printer to buy is no exception.

The first question you should ask is, "How do I plan to use my personal computer printer?" The following checklist will help you answer this question:

1. How much can I afford to pay? $_____
2. What computer am I going to connect it to? _____
3. Does my computer have a serial or parallel printer port? _____
4. What physical size/weight should it be? _____
5. What software will drive the printer? _____
6. What print quality do I need? _____
7. What special characters do I need? _____
8. What print sizes do I want? _____
9. What graphics capabilities do I need? _____
10. What size/weight paper do I want to use? _____
11. How fast must it print? _____
12. How many carbon copies must it print? _____

13. How often and what volume must it print? _____

14. What special paper handling must it perform? _____

15. What noise level is acceptable? _____

16. What is the cost of paper/ribbon/ink? _____

17. How many ink colors do I need? _____

18. What is the short-term/long-term maintenance? _____

19. What warranty do I want? _____

20. What type of service do I need? _____

When evaluating the above features, you might rate the features as essential (+++), desirable (++), and nice but can do without (+). In this way, you'll understand what trade-offs you're willing to make.

This chapter and the following Product Reviews for Printers will help you find a printer that best meets your needs.

How Much Can I Afford to Pay?

The more you want the printer to do, the more the printer costs. In general, better print quality, higher speed, versatility, and durability cost more.

Even if money is no object, don't get carried away. More features could mean more complications and less reliability. The more a machine can do, the more parts there are to break. Be sensible and realistic in evaluating your needs.

Prices for personal computer printers range from $100 to $5000. Good quality printers cost from $500 to $2000. CAD/CAM quality plotters tend to be more expensive.

What Computer Am I Going to Connect It To?

Unfortunately, computer peripherals are not like stereo components. You can't buy this brand of disk drive, that brand of computer, and another brand of printer and expect that they'll just plug in and work together.

Buying the entire computer system from the same store is an advantage since the store "guarantees" that the software/hardware system is compatible. I put "guarantees" in quotes because it should not be inferred, but verified and preferably put in writing. The best

proof that a system will work is to see it operating before buying.

Adding a printer to an existing system may present a more limited choice. Some printers may not interface (work) with specific computers and programs. The computer dealer should be able to advise you on brands and models which are compatible. If possible, see the printer hooked to the computer and operating with the software before buying.

Buying through mail order may not be as inexpensive as you may think. Special cables, connectors, and software modification may be needed before the computer can communicate with the printer. For example, the Kaypro II computer has both serial and parallel ports, but is designed to work with a parallel printer (more about interfaces later). Interface devices and software modification may cost much more than is saved. The hacker can get away with mail order purchasing—the novice may get stuck.

Does My Computer Have a Serial or Parallel Printer Port?

Most computers and printers have serial or parallel interfaces and some have both. For the novice, *port* refers to the kind of plug and cable that connects one device to the other—a round plug won't fit into a square hole.

An interface is actually a bit more complicated in that it determines the manner in which the printer communicates with the computer. A serial interface allows the information to come to the printer bit by bit. Computer words (characters) are composed of electrical signals which represent 1s and 0s, in the same way that dots and dashes are used in Morse Code. In serial communication the 1s and 0s pass in single file from one device to the other over one wire (it takes two wires to complete the electrical circuit). Since eight bits (1s and 0s) represent a computer word (character), eight 1s and 0s must pass through the wire for the printer to receive one character.

The parallel interface has eight wires (sixteen to complete the electrical circuit). All eight bits of a character travel in parallel through the eight wires and arrive at the printer simultaneously. Parallel transmission is faster; however, the personal computer still generates information many times faster than the printer can print it. Transmission speed is not the deciding factor when selecting serial or parallel interfaces.

The Centronics and Dataproducts parallel interfaces are commonly used with printers. The RS-232C serial interface and the IEEE-488 standard are also used. Be sure to buy a printer that is compatible with the computer port or be prepared to buy an adaptor (which may be expensive) to allow the computer to communicate with the printer.

The cable that connects the printer to the computer may be a special one. The store should provide a cable for $25 to $50, depending on the type and length. Serial cables are less expensive and should be used in applications in which long cables are required.

What Physical Size/Weight Should It Be?

Some printers are so portable that they can be carried in a case like a portable typewriter. Some printers like the Bytewriter are portable typewriters equipped with special computer interface circuits. Although these units are slow and are not designed for heavy use, they do provide unique versatility. You can disconnect the "printer" and use it as an electric typewriter when traveling or away from the computer.

Large printers like the Diablo 620 and MPI Printmate 150 are quite heavy and may need special stands or tables for mounting. If the paper feeds from the bottom of the printer, the printer table must have a hole in its top through which the paper can be threaded.

You should balance portability, durability, and desktop space along with the application for the printer.

What Software Will Drive the Printer?

A printer may feature a variety of printing capabilities. However, the programs or software (computer instructions) may not be able to take advantage of them. For example, a printer may be able to print superscripts and subscripts, but the word processor may lack commands to direct the printer to do so. Another possibility is that the software will drive the printer; however, it takes numerous command statements to accomplish this task. For example, the Microline 92 used with the Ohio Scientific (OSI) word processor requires ^01B^043_____^01B^044 to direct it to begin and end underlining. You might find this series of commands difficult to memorize and time consuming to use. Those who know how to program may be

able to modify the software so the printer commands will work more efficiently. Nonprogrammers can only estimate how much these programming services will cost and then trust that everything will work out.

You should see a demonstration of the printer using the intended software before making a decision to buy.

What Print Quality Do I Need?

Print quality refers to data processing quality, correspondence quality, typewriter quality, or letter quality. The nature of your application dictates which choice is best.

A broad selection of dot-matrix printers produce data processing quality. Matrix printers form characters by printing a number of small dots that form the symbol image. The print head is composed of a column of seven to nine wires. As the print head moves horizontally across the paper, these wires are "activated" five to nine times per printed symbol. The wires may strike the ink-impregnated ribbon and paper like small hammers (impact printing), or electricity may heat the wires and "burn" an image onto specially coated paper (thermal printing), or electricity may pass from the wires through special paper to form an image (electrostatic printing). Some of the newer printers squirt tiny jets of ink onto the paper.

The style of character formed by dot-matrix printers varies considerably. Some printers will only form uppercase letters, while others produce both upper- and lowercase. Printers that produce true descenders yield copy that is easier to read. These printers form the tails of letters such as "y," "j," and "g" below the base line.

Dot-matrix printers can produce correspondence-quality print as well as other printing enhancements by passing the print head over the same line more than once. To make clearer and darker images, dual- or multiple-pass printers increase the density of the dots. Multiple passes also allow the printer to produce bold type styles and other special effects.

Letter-quality printers produce fully formed characters that resemble typewriter quality. The print head may be a daisy wheel, ball, or thimble. High technology (and expensive) printers use lasers to "burn" fully formed characters onto the paper.

The daisy wheel printer head is a 3- to 4-inch diameter plastic assembly of wheel spokes (daisy petals) with symbols arranged

around the circumference. As the wheel spins, a striker (hammer) hits the appropriate petal, which strikes the ribbon to produce the desired letter. The thimble design works along the same principles as the daisy wheel. The typeball is similar to that of the IBM Selectric typewriter. Each of these heads is available in metal, which lasts longer. As with typewriters, letter-quality printers vary in print styles and fonts. By selecting different heads, the user can quickly change styles.

Cloth, single-strike carbon, and multiple-strike carbon ribbons also affect the quality of print. Ink-impregnated cloth ribbons last longer, but tend to produce a wider, less consistent and fuzzier image than do carbon ribbons. Since carbon ribbons do not last as long as cloth, they may be more expensive to use. Multiple-strike carbon ribbons may be a good compromise for economical, attractive printing.

The better the print quality, the higher the price. If you only intend to print program listings and accounting reports, an inexpensive dot-matrix printer may be the right choice. However, if you want to send personalized letters to clients, a letter-quality printer would be more appropriate.

What Special Characters Do I Need?

Some applications require special printing capabilities. For example, engineers, musicians, and mathematicians need to produce characters unique to their fields. Many foreign languages use special letters and symbols.

Some dot-matrix printers may be "programmed" to print italics, special characters, or foreign languages. Letter-quality printers may use different balls, thimbles, or daisy wheels to produce special symbols.

For superscripts and subscripts, the printer must be able to move the platen (roller) or paper-feed mechanism in small increments up or down. If special capabilities are needed, you must keep this in mind when selecting a printer and word processing program.

What Print Sizes Do I Want?

Dot-matrix printers typically produce 10, 12, or 17 (16.5) characters per inch (cpi). Compressed print or pitch (17 cpi) may allow you to

print 136 columns on 8.5-inch paper. Printers may also produce expanded print (5 or 8 cpi) for report headings. The application will determine the print size(s).

What Graphics Capabilities Do I Need?

Although matrix and letter-quality printers are capable of producing graphics, plotters are specially equipped to produce quality drawings, such as those required by architects, draftsmen, and engineers. When selecting a plotter, you should decide what resolution is required, what speed is needed, what size is suitable, and what material the plotter will draw on. Some plotters use several colored pens—although, usually, only one pen is used at any given time.

If fine graphics are not required, creative users may achieve quite passable graphics with dot-matrix printers. Dot-addressable graphics allow you to control each wire in the print head and thus control where each individual dot is printed. By creating unique character sets, you can print detailed pictures. Custom software may, however, be required to invoke these features. It is best to see a demonstration before buying.

What Size/Weight Paper Do I Want to Use?

The width of the paper needed by the application will determine the width of the printer. Although 136-character-wide reports may be printed on 8.5-inch-wide paper by using the 17 cpi font size, this small character size may not be readable. The most common paper size is 8.5 × 11 inches, after the tractor-feed perforations are torn off. However, thermal and electrosensitive printers use paper rolls less than five inches wide. Many printer models offer wider platens and tractors for business users.

Light-weight paper and shipping labels may not feed through the mechanism without slipping or tearing. Some printers may not handle thick bundles such as large manila envelopes or multiple carbon copies. You should try feeding the paper(s) through the printer before buying.

How Fast Must It Print?

Manufacturers' specifications for printing speed are difficult to compare. Speed is not just how fast the print head moves back and

forth across the page. Many printers "plan ahead" to improve their efficiency and to avoid wasted movement.

In general, a printer is slow if it produces under 50 characters per second (cps). In contrast, a typist working at 60 words per minute is typing 6 characters per second. Moderate-speed printers range up to 160 to 180 cps, and serve most personal computer users quite well. Letter-quality printers tend to be slower than dot-matrix printers: typical speeds are 12 to 25 cps. When dot-matrix printers are operated in enhanced, double-strike modes, their speed is often one-half or one-third the top rated speed.

Printer efficiency may be increased in several ways. For example, some printers print the first line from left to right and the next line from right to left. Bidirectional printing saves the time spent in moving the print head back to the left margin before proceeding to the next line. Other printers use short-line-seeking logic to ascertain when all of the characters for a given line have been printed. Once a line is complete, the printer proceeds to the next line of print. If the application requires printing a narrow column of figures on the left margin, this printer will work considerably faster than one which must move the print head all of the way to the far right margin before printing the next line.

Some printers are equipped with large buffers (memory) capable of storing the printed information and feeding it to the printer as the material is produced. If the entire document can be stored in the printer buffer, the computer is free to perform other tasks. Although this doesn't increase the speed of the printer, the buffer may improve the efficiency of the computer.

The only way to truly compare printing speeds is to time several different printers performing the same tasks.

How Many Carbon Copies Must It Print?

Thermal, electrostatic, and ink-jet printers cannot produce carbon copies. Impact printers can produce carbons, but their number and quality will vary considerably from one printer to another. Bulky, multiple carbons may not feed properly through the mechanism. The weight of the paper also affects the quality of the carbon image. Try the application before buying.

Since printers are so much faster than typewriters, you may want

to print an original to mail and a second copy for the file without worrying about carbons.

How Often and What Volume Must It Print?

A 100% duty cycle means producing filled pages hour after hour. Printers used at their 100% duty cycle will be prone to failure. Most personal computer printers aren't built for continuous use.

The printer is the slowest device in the information processing chain. Therefore, if much printing is required, a slow printer will tie up the computer's time, unless it has a large buffer.

You should compare price and volume to achieve an efficient, workable balance.

What Special Paper Handling Must It Perform?

Printers use three methods for moving or feeding paper past the print head: friction feed, pin feed, and tractor feed.

Friction feed is similar to that used by a conventional typewriter. The rubber, plastic, or metal roller pinches the paper against the printer housing and twists or rotates to advance the paper. Friction feed is desirable for printing single sheets, envelopes, and letterhead. No special paper is needed.

When printing long, continuous documents, friction feed may allow the paper to slip from top to bottom or crawl from side to side. You may have to periodically stop the printer and adjust the paper to maintain proper margins and alignment. Applications which require multiple strikes and accurate registration (mailing labels and forms) aren't suitable for friction-feed printers.

Pin-feed and tractor-feed printers use a paper-feed mechanism similar to that used by a 35-mm camera to advance film. Sprockets or pins on the outer margins of the paper-feed mechanism mate with holes on the margins of the paper. Both vertical and horizontal alignments are maintained from page to page. Some pin feeds will also friction-feed envelopes and letterhead. Applications that require printing mailing labels, preprinted forms, and lengthy reports are best served with pin- or tractor-feed printers. Some pin-feed printers may only work with a single-width paper, for example, 8.5 inches. Push pin-feed printers use adjustable pin widths to accom-

modate narrower paper such as mailing labels. The push pin-feed pushes the paper through the mechanism instead of pulling it through.

Tractor-feed mechanisms may be built-in or add-on attachments. The add-on tractor may increase the cost of the printer by $50 to $300. Tractor feeders are adjustable to many widths and generally pull the paper past the printer head.

An automatic single-sheet handler allows the user to print hundreds of individual sheets of paper or letterhead without operator intervention to load paper. Envelope handlers operate in much the same way. You can avoid having to buy these add-ons by purchasing laser-cut continuous fan-fold letterhead and window envelopes. When the hole-punched strips are torn from laser-cut paper, the perforation remnants cannot be seen. This paper tends to be more expensive, so you must weigh the relative costs of special paper versus a sheet feeder.

Some printers are equipped with baskets to hold the printed material as it's ejected, thus avoiding tangles and wrinkled material.

What Noise Level Is Acceptable?

Impact printers are noisy. Thermal, electrostatic, ink-jet, and laser printers are quiet. Some printers such as the Diablo 620 are equipped with sound-proof housings and covers to minimize noise. Room acoustics also contribute to the perceived noise from the printer.

If possible, an impact printer should be located away from people who need to communicate, telephones, and acoustic modems. If noise is a potential problem in the work environment, the printer should be compared with others before buying—60 to 70 decibels is considered a tolerable noise level for a printer.

What Is the Cost of Paper/Ribbon/Ink?

Buying the printer is only part of the expense of using one. Thermal and electrostatic printers require expensive paper that may be difficult to find. Printers that use cartridge ribbons cost more to use than those using ribbon spools. Ink-jet printers must have ink cartridges replaced. You should evaluate how frequently these perishable sup-

plies must be replenished and how much this will add to the expense of operating the printer.

You should also check on the availability of these supplies. A printer isn't worth much if ribbons are impossible to find. Ribbon reinkers, which cost approximately $50, may be a worthwhile investment.

How Many Ink Colors Do I Need?

Several printers have entered the market with color printing capabilities; for example, the IBM Color Printer. Some use a multiple-striped ribbon similar to the old red and black ribbons used in typewriters. Others use ribbons with differently colored segments. The first fourth of the ribbon length may be yellow, the next fourth blue, and so on. These printers usually print one color on the page and then make another pass to add another color. Colors may be mixed to produce different effects. Plotters use multiple pens, like ballpoints, to draw different colors. Each color is added one at a time. The next few years will be a high-growth period for color printers. Currently, there is little software available to support color printers and plotters.

What Is the Short-Term/Long-Term Maintenance?

Other than the ribbon, the printer part that is most likely to wear out is the print head. Manufacturers usually rate the number of characters that a print head will produce. Keep in mind that if a double- or triple-strike mode is used, as with bold and correspondence-quality print, the print head is getting double or triple use. Also, bold or enhanced printing may be harder on the head since the pins may actually strike the paper harder.

Consider both the price of the print head and the ease or difficulty of installing a new one. Some print heads last millions of characters, cost $10, and may be installed by the user. Others may cost considerably more.

A continuously used printer is likely to fail. Some users prefer to buy a service contract for printers or even to buy a back-up printer for emergencies. It's wise to get references or recommendations from other users on printer reliability.

What Warranty Do I Want?

A ninety-day warranty is typical for printers. Ask to see the written warranty to make sure that all parts are included and that labor costs will be paid. Some warranties only cover parts. Also, find out if the dealer provides warranty service or must ship the unit to another service facility. The manufacturer won't pay freight expenses, and shipping adds to turnaround time and the likelihood of freight damage. Save the original carton and packing.

What Type of Service Do I Need?

Find out what kind of service the dealer provides. Does the dealer repair the printer on site or must you take the printer into the shop? Will the dealer provide a loaner? Does the dealer stock parts and employ full-time, factory-trained service personnel? All of these factors affect the quality of service and turnaround time.

The Checklist Provides the Answers

Once the checklist is complete and rated for priorities, the type of printer required for the application will be clear. Compare these ratings to the following product reviews to determine which makes and models you want to examine in detail.

Dot-Matrix Printers

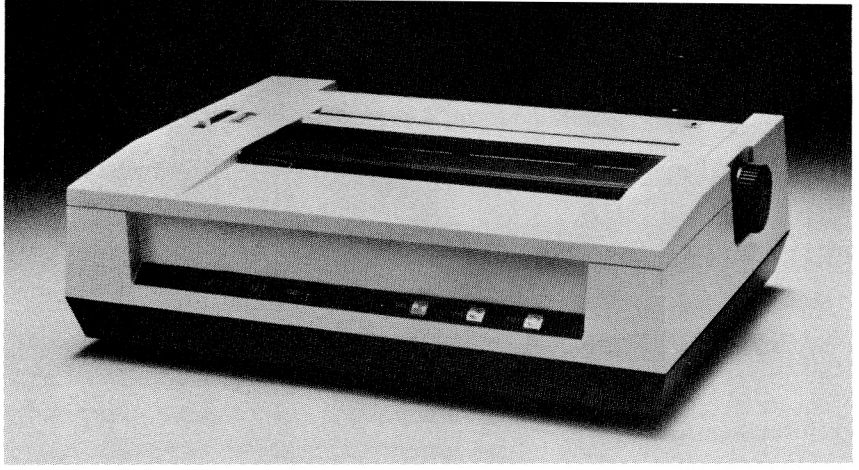
PROWRITER 8510B AND 1550B DOT-MATRIX PRINTERS

C. Itoh Electronics, Inc.
Model 8510B: $745; Model 1550B: $995

PERFORMANCE RATING
Performance: Good
Documentation: Good
Ease of Use: Excellent
Usage: Light Commercial/Home - Good

FEATURES
Printing Speed: 120 characters per second (cps)
Throughput Rate: 8510B - 63 lines per minute (lpm); 1550B - 70 lpm
Bidirectional, short-line-logic seeking
Matrix: 9 × 9
Print Size: 10, 12, and 17 cpi; double width
Proportional spacing
True descenders; superscript/subscript
Enhanced; double-strike; underlining
Column Width: 8510B - 80 characters per line (cpl) at 10 cpi; 1550B - 136 cpl at 10 cpi
Paper Size: 8510B - maximum: 10.0 in.; minimum: 4.5 in.
1550B - maximum: 15.5 in.; minimum: 4.5 in.
Paper Feed: Push, adjustable, bidirectional pin feed, friction feed/rear or top feed
Ribbon: Cartridge
Carbon Copies: Original plus three copies
Indicators: Select, out of paper, and power on/off
Graphics Capabilities: Resolution 144 × 160 dots
Character Sets: 13 International
Buffer: 8510B - 1K (2K optional); 1550B - 4K (16K optional)
Interface: Centronics parallel or RS-232C serial
Baud Rate: Up to 9600 in serial mode
Dimensions: 8510B - width 15.5 in. × height 4.5 in. × depth 11 in.
1550B - width 20 in. × height 5 in. × depth 11.8 in.
Weight: 8510B - 19 lbs.; 1550B - 24 lbs.

The Prowriter 8510B and 1550B manufactured by C. Itoh Electronics produces a very fine quality print in the single-pass mode and excellent matrix quality in the double-strike mode. In fact, in single-strike mode at 120 cps, the Prowriter's print quality is nearly



8510B Serial Dot-Matrix Printer. Courtesy of C. Itoh Electronics, Inc.

as good as that of the Epson FX-80 and Okidata Microline 92 in correspondence (double-strike) quality mode at one-third the speed.

The primary differences between the two Prowriter models is the carriage length. The 8510B handles 10-inch-wide paper and the 1550B accommodates 15.5-inch-wide paper. In addition, the 1550B has a slightly larger buffer memory.

This matrix printer does everything a user could expect and a bit more. The pin-feed mechanism pushes the paper through the platen and can be adjusted to variable widths, like a tractor. The user doesn't incur any extra expense by buying an optional tractor, as with the Epson and Okidata. The pin feed adjusts down to 4.5 inches to accommodate mailing labels and narrow forms. The friction platen allows the user to single-sheet feed letterhead and envelopes.

The Prowriter 8510B and 1550B are not as noisy as most matrix printers. The user can install the cartridge ribbon and access DIP switches quite easily.

The manual is written in clear language and is technically correct. A chart summarizing control codes is very helpful in getting the printer to perform its many functions.

SUMMARY

The C. Itoh 8510B and 1550B dot-matrix printers are excellent choices for home or small-business users. They offer all of the features that a user could want as well as reliable performance. In single-pass mode at 120 cps, the 8510B and 1550B printers produce a print quality rivaling the Epson FX-80 and Okidata Microline 92 in their double-strike mode at one-third the speed. The documentation is good and the manufacturer offers a one year warranty.

PROWRITER 8510S AND 1550S DOT-MATRIX PRINTERS

C. Itoh Electronics, Inc.
Model 8510S: $825; Model 1550S: $1225

PERFORMANCE RATING
Performance: Good
Documentation: Good
Ease of Use: Excellent
Usage: Light Commercial/Home - Good

FEATURES
Printing Speed: 120 characters per second (cps) - pica 10 characters per inch (cpi); 180 cps - draft mode (9 × 9)
Throughput Rate: 70 lines per minute (lpm) - pica 10 cpi; 100 lpm - draft mode
Bidirectional, short-line-logic seeking
Matrix: 9 × 9
Print Size: 10, 12, and 17 cpi; double width
Proportional spacing
True descenders; superscript/subscript
Enhanced; double-strike; underlining
Column Width: 8510S - 80 cpl at 10 cpi
1550S - 136 cpl at 10 cpi
Paper Size: 8510S - maximum: 10.0 in.; minimum: 4.5 in.
1550S - maximum: 15.5 in.; minimum: 4.5 in.
Paper Feed: Push, adjustable, bidirectional pin feed, friction feed, rear or top feed
Ribbon: Cartridge
Carbon Copies: Original plus three copies
Indicators: Select, out of paper, and power on/off
Graphics Capabilities: Resolution 144 × 160 dots
Character Sets: 13 International, including italics
Hex dump for programmers
High-speed carriage return
Buffer: 4K (16K optional)
Interface: Centronics parallel or RS-232C serial
Baud Rate: Up to 9600 in serial mode
Dimensions: 8510S - width 16.5 in. × height 5.4 in. × depth 11.7 in.
1550S - width 21.5 in. × height 5.6 in. × depth 11.8 in.
Weight: 8510S - 18 lbs.; 1550S - 24 lbs.

The Prowriter 8510S and 1550S manufactured by C. Itoh Electronics produce a very fine quality print in the single-pass mode and

excellent matrix quality in the double-strike mode. In single-strike mode at 120 cps the Prowriters' print quality is nearly as good as that produced by the Epson FX-80 and Okidata Microline 92 in correspondence (double-strike) quality mode at one-third the speed.

The primary differences between the two Prowriter models is the carriage length. The 8510S handles 10-inch-wide paper and the 1550S accommodates 15.5-inch-wide paper. In addition, the 8510S and 1550S print faster than the "B" series and have a larger buffer capacity.

This matrix printer does everything a user could expect and a bit more. The pin-feed mechanism pushes the paper through the platen and can be adjusted to variable widths like a tractor. The user doesn't incur any extra expense by buying an optional tractor, as with the Epson and Okidata. The pin feed adjusts down to 4.5 inches to accommodate mailing labels and narrow forms. The friction platen allows the user to single-sheet feed letterhead and envelopes.

The Prowriter 8510S and 1550S are not as noisy as most matrix printers. The user can install the cartridge ribbon and access DIP switches quite easily.

The manual is written in clear language and is technically correct. A chart summarizing control codes is very useful in getting the printer to perform its many functions.

SUMMARY

The C. Itoh 8510S and 1550S dot-matrix printers are an excellent choice for home or small-business users. They offer all of the features that a user could want as well as reliable performance. In single-pass mode at 120 cps, the 8510S and 1550S produce a print quality rivaling the Epson FX-80 and Okidata Microline 92 in their double-strike mode at one-third the speed. The documentation is good and the manufacturer offers a one year warranty.

PROWRITER 8510SC AND 1550SC DOT-MATRIX COLOR PRINTERS

C. Itoh Electronics, Inc.
Model 8510SC: $925; Model 1550SC: $1325

PERFORMANCE RATING
Performance: Good
Documentation: Good
Ease of Use: Excellent
Usage: Light Commerical/Home - Good

FEATURES
Printing Speed: 120 characters per second (cps) - pica 10 characters per inch (cpi); 180 cps - draft mode (9 × 9½)
Throughput Rate: 74 lines per minute (lpm) - pica 10 cpi; 100 lpm - draft mode
Bidirectional, short-line-logic seeking
Matrix: 9 × 9
Three-color ribbon cartridge
Printable in up to seven different colors (dual cartridge)
Print Size: 10, 12, and 17 (cpi); double width
Proportional spacing
True descenders; superscript/subscript
Enhanced; double-strike; underlining
Column Width: 8510SC - 80 characters per line (cpl) at 10 cpi
1550SC - 136 cpl at 10 cpi
Paper Size: 8510SC - maximum: 10.0 in.; minimum: 4.25 in.
1550SC - maximum: 15.5 in.; minimum: 4.25 in.
Paper Feed: Push, adjustable, bidirectional pin feed, friction feed/rear or top feed
Carbon Copies: Original plus three copies
Indicators: Select, out of paper, and power on/off
Graphics Capabilities: Resolution 144 × 160 dots
Character Sets: 13 International, including italics
Hex dump for programmers
High-speed carriage return
Buffer: 4K (16K optional)
Interface: Centronics parallel or RS-232C serial
Baud Rate: UP to 9600 in serial mode
Dimensions: 8510SC - width 16.5 in. × height 5.4 in. × depth 11.7 in.; 1550SC - width 21.5 in. × height 5.6 in. × depth 11.8 in.
Weight: 8510SC - 18 lbs.; 1550SC - 24 lbs.

The Prowriter 8510SC and 1550SC feature both high-speed and color enhancements. The seven-color printing capabilities produce precise multicolor business graphics at 120 cps and color sketching at 180 cps.

The Prowriter 8510SC and 1550SC also produce a very fine quality black print in the single-pass mode and excellent matrix quality in the double-strike mode. In single-strike mode at 120 characters per second, the print quality of the Prowriter is nearly as good as that produced by the Epson FX-80 and Okidata Microline 92 in correspondence (double-strike) quality mode at one-third the speed.

The primary differences between the two Prowriter models is the carriage length. The 8510SC handles 10-inch-wide paper and the 1550SC accommodates 15.5-inch-wide paper. In addition, the 8510SC and 1550SC print faster than the "B" series and have a larger buffer capacity.

These matrix printers do everything a user could expect and more. For example, since the pin-feed mechanism pushes the paper through the platen, it can be adjusted to variable widths like a tractor. The user doesn't incur any extra expense by buying an optional tractor, as with the Epson and Okidata. The pin feed adjusts down to 4.25 inches to accommodate mailing labels and narrow forms. The friction platen allows the user to single-sheet feed letterhead and envelopes.

The Prowriter 8510SC and 1550SC are not as noisy as most matrix printers. The user can install the three-color cartridge ribbon and access DIP switches quite easily.

The manual is written in clear language and is technically correct. A chart summarizing control codes is very useful for getting the printers to perform their many functions.

SUMMARY

The C. Itoh 8510SC and 1550SC dot-matrix printers are excellent color printers for home or small-business users. They offer all of the features that a user could want as well as reliable performance. In single-pass mode at 120 cps, the 8510SC and 1550SC produce a single-color print quality rivaling the Epson FX-80 and Okidata Microline 92 in double-strike mode at one-third the speed. The documentation is good and the manufacturer offers a one year warranty.

DS-180 MATRIX PRINTER

Datasouth Computer Corp.
$1595

PERFORMANCE RATING
Performance: Good
Documentation: Poor
Ease of Use: Good
Usage: Commercial - Good

FEATURES
180 characters per second (cps)
132 columns at 10 characters per inch (cpi)
Character Pitch: 5, 6, 8, 10, 12, or 16 cps
True descenders, compressed and expanded print
Matrix: 9 × 7 draft mode at 220 cps; high-resolution dot-addressable graphics
Multiple Forms: Up to six parts
Form Width: 3 in. to 15 in.
Paper Feed: Pinch rollers (friction) - front feed; tractor feed - bottom and front feed
Ribbon: Cartridge
Interface: Centronics parallel or RS-232C serial
Communications Rates: 110 to 9600 baud
Buffer: 2000 characters (2K)
Dimensions: height 7 in. × width 24 in. × depth 16 in.
Weight: 35 lbs.

Datasouth DS-180 Matrix Printer. Courtesy of Datasouth Computer Corp.

The Datasouth DS-180 is a fine matrix printer for small business applications. Its heavy-duty construction provides reliable and continuous service.

The throughput rate of the DS-180 is faster than most printers in its price range. At 180 cps, with bidirectional printing, and short-line-logic seeking, the DS-180 produces an average of 200 lpm (three single-spaced pages). The print head is rated to last 650 million characters.

The 9 × 7 dot-matrix character pattern with true descenders produces a legible character set. The DS-180 prints up to 132 columns wide at 10 cpi. Compressed fonts (12 and 16.5 cpi) and expanded fonts (5, 6, and 8.25 cpi) may be selected with either hardware or software controls.

The DS-180 does not offer a multiple-pass feature for producing correspondence quality, bold print, or other such features. The printer does offer the ability to customize a special character set. However, the documentation discusses the procedures for accomplishing this at the "hacker" (advanced programming) level. Additional instructions are also needed for operating the graphics mode.

The fabric ribbon cartridge is easy to install and prints an estimated 3 to 4 million characters. A unique feature of the DS-180 is its ability to produce up to six carbon copies without significant degradation of quality. Most printers in this price range or below can only produce two to four carbon copies.

Hardware Programming

An integral keypad with a light-emitting diode (LED) display allows the user to enter (initialize) commonly used printer settings into a nonvolatile (nonerasable) memory. The instructions for entering these variables are quite clear and easy to perform. Programmable functions include baud rate (110 to 9600), form length (1 to 132 lines per page), top and bottom margins, left and right margins, horizontal and vertical tabs for filling in preprinted forms, font sizes (5, 6, 8.25, 10, 12, and 16.5 cpi), lines per inch (6 or 8), and so forth. One function is a self-test that verifies proper printer operation. Once these variables are programmed into the printer, turning the printer off and on will not alter the settings. The hardware settings may be overridden with software commands; however, the manual needs much better instructions for telling the novice how to do this.

The user may also reverse the direction in which the paper moves

through the printer. The 1/48 of an inch form-alignment feature is convenient for some applications.

Configuring the printer to a specific terminal or software package may be difficult due to the lack of documentation. The manual provides a standard ASCII character set and some hexadecimal and decimal codes which are inconsistently labeled, but does not give the codes for all functions. Without them, interfacing is difficult at best.

SUMMARY

The DS-180 is an efficient dot-matrix printer for small-business applications. The documentation is somewhat deficient, but the integral keypad programming functions are a big plus for business operations, where employees may not be trained to embed print commands. The rugged construction and design should make the DS-180 a reliable printer for heavy use.

EPSON RX-80 AND RX-80 F/T MATRIX PRINTERS

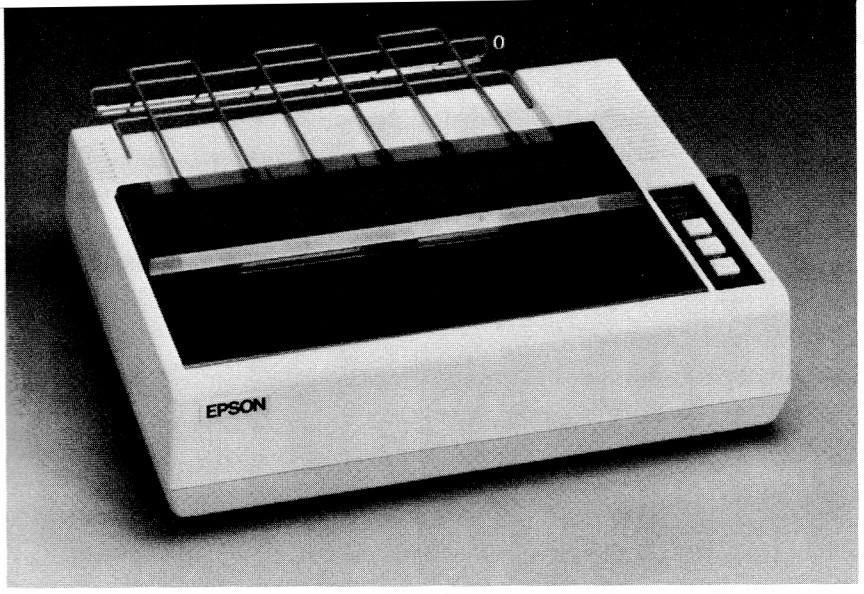
Epson America, Inc.
RX-80: $399; RX-80 F/T: $499

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Excellent; Hacker - Good
Ease of Use: Excellent
Usage: Home/Light Commercial - Good

FEATURES
Speed: 100 characters per second (cps)
Matrix: 9 × 9 draft quality; 18 × 18 correspondence quality
Bidirectional, logic seeking
True descenders, subscript/superscript, underlining
Character Sets: Proportional, elite, pica, italics, 11 international, 32 graphic characters
Condensed, expanded, double-strike, emphasized
Print Sizes: 5, 8.5, 10, 12, and 17 characters per inch (cpi)
Graphics: 60, 80, 90, 120, and 240 dots per inch
Paper Handling: RX-80 - Tractor only; RX-80 F/T - Friction and tractor
Paper Path: Rear
Paper Width: 4 in. to 10 in.; 80 columns - pica; 40 columns - enlarged; 137 columns - condensed
Ribbon: Cartridge
Carbon Copies: Original plus two copies
Indicators: On-line, on/off, ready, paper out
Interface: Centronics parallel; RS-232C serial (optional); IEEE-488 (optional)
Buffer: 1 line; 2K optional with serial interface
Dimensions: width 15 in. × depth 12.5 in. × height 4 in.
Weight: 11 lbs.

The Epson matrix printers serve as a standard by which many other printers are judged. Their light weight, low profile, and quiet performance makes these printers appropriate for both home and office use.

The primary difference between the two RX models pertains to paper handling. The RX-80 works only with a tractor feed, making single-sheet feeding impractical. Users wanting to print on office letterhead may want to purchase the RX-80 F/T (Friction/Tractor) model instead. Both of these printers accommodate from 4- to 10-inch-wide paper and print 80 columns at 10 characters per inch.



Epson RX-80 Dot-Matrix Printer. Courtesy of Epson America, Inc.

Denser printing produces up to 137 columns per line. The print quality is quite good in the draft-quality mode and excellent in the correspondence mode.

To print envelopes and individual labels, the RX-80 F/T tractor must be removed and the out-of-paper sensor "tricked" by placing a card over it. Once the label or envelope is in position, it must be straightened. I found the whole process awkward, frustrating, and time consuming.

The documentation is almost overwhelming because there is so much of it. The spiral-bound manuals are well illustrated, clearly referenced, and easy to use. Control codes are summarized for quick look-up. The technical manual costs extra.

Accessing the DIP switches requires removing the case. Although this isn't a frequent need, Epson could have done better here.

Epson offers a one-year warranty, which is long for computer equipment. Dealers report very good performance from the Epson printers.

SUMMARY

The Epson RX-80 and RX-80 F/T matrix printers provide low-cost, flexible, quiet printing for both business and home users. The only disadvantage to the RX-80 is that it cannot handle friction feed. The RX-80 F/T may be better suited for business use since it can print on single sheets, such as company letterhead. Neither printer conveniently handles envelopes and individual mailing labels. The documentation is excellent and the service record is the best.

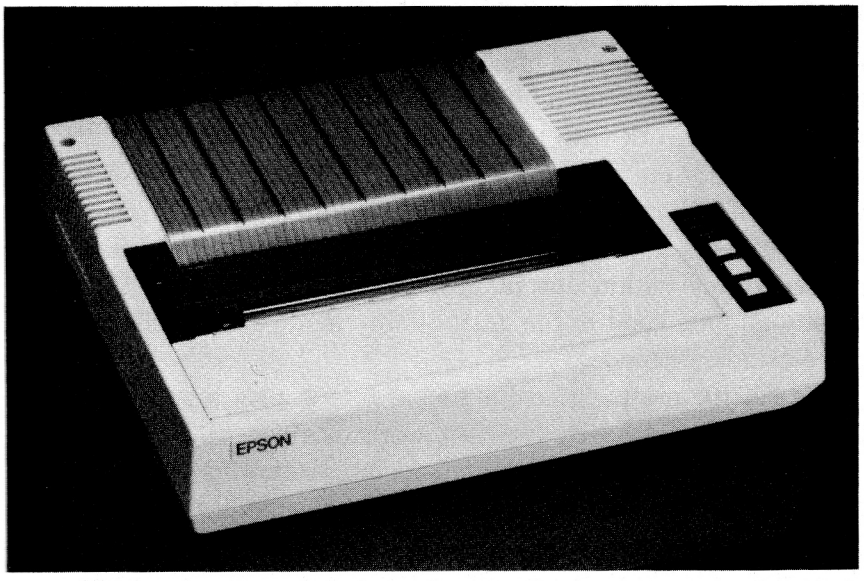
EPSON FX-80 AND FX-100 MATRIX PRINTERS

Epson America, Inc.
FX-80: $699; FX-100: $895

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Excellent
Usage: Commercial - Excellent

FEATURES
Speed: 160 characters per second (cps)
Matrix: 9 × 9 draft quality; 18 × 18 correspondence quality
Bidirectional, logic seeking
True descenders, subscript/superscript, underlining
Character Set: Proportional, elite, pica, italics, 8 international, 256 programmable downloadable characters
Condensed, expanded, double-strike, emphasized
Characters per line: FX-80 - 80 to 132, depending on pitch; FX-100 - 136 to 233, depending on pitch
Print Sizes: 5, 6, 8.5, 10, 12, and 17 cpi
Graphics: 60, 72, 80, 90, and 120 dots per inch (dpi)
Paper Handling: FX-80 - Pin-feed platen 9.5 in. to 10 in.; adjustable snap-off tractor, optional
FX-100 - Friction and tractor
Paper Path: Rear
Paper Width: FX-80 - 4 in. to 10 in. with optional tractor; 9.5 in. to 10 in. with friction feed
FX-100 - 4 in. to 16 in. with tractor; 7.25 in. to 8.5 in. with friction feed.
Ribbon: Cartridge
Carbon Copies: Original plus two copies
Indicators: On-line, on/off, ready, paper out
Interface: Centronics parallel; RS-232C serial (optional); IEEE-488 (optional)
Buffer: 2K (approximately 2000 characters)
Dimensions: FX-80 - width 16 in. × depth 12.5 in. × height 4 in.
FX-100 - width 31 in. × depth 14 in. × height 6.5 in.
Weight: FX-80 - 15 lbs.; FX-100 - 23 lbs.

The Epson matrix printers serve as a standard by which many other printers are judged. Their light weight, low profile, and quiet performance makes these printers appropriate for both home and office use.



Epson FX-80 Dot-Matrix Printer. Courtesy of Epson America, Inc.

Epson FX-100 Dot-Matrix Printer. Courtesy of Epson America, Inc.

The primary differences between the two FX series models pertain to paper size and handling. The FX-80 has a pinfeed platen that handles paper from 9.5 to 10 inches. An optional tractor allows the user to adjust the feed from 4 to 9 inches. Users wanting to print

narrow forms or mailing labels may want to purchase the optional tractor. The FX-100 has a built-in friction and tractor feed. The friction feed will work with paper from 7.25 inches to 8.5 inches wide, and the tractor feed will work with paper from 4 inches to 16 inches wide. An additional feature is the short-form tear-off bar which lets the user tear off computer-generated paychecks and other preprinted forms within one inch of the last printed line. The print quality is quite good in the draft-quality mode and excellent in the correspondence mode.

The FX-100 prints 136 columns per line in pica type size, which provides more flexibility for office use.

To print envelopes and individual labels, the FX-80/100 tractor must be removed and the out-of-paper sensor "tricked" by placing a card over it. Once the label or envelope is in position, it must be straightened. I found the whole process awkward, frustrating, and time consuming.

The documentation is almost overwhelming because there is so much of it. The spiral-bound manuals are easy to read, well illustrated, and clearly referenced. Control codes are summarized for quick look-up. The documentation also has a section that tells the user how to control the printer from BASIC. The technical manual costs extra.

In contrast with the RX series, the DIP switches are easily accessed.

Epson warrants its printers for one year. Dealers report very good performance.

SUMMARY

The Epson FX matrix printer series provides low-cost, flexible printing for both business and home users. The wider carriage FX-100 may be better for business use since it can print up to 136 columns in pica type and has a built-in, adjustable tractor. Neither printer conveniently prints individual mailing labels and envelopes. The documentation is excellent and the service record is the best. This is Epson's top of the line.

RITEMAN DOT-MATRIX PRINTER

Inforunner Corp.
$399

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Fair; Hacker/Programmer - Good
Ease of Use: Acceptable
Usage: Home - Good; Commercial - Fair

FEATURES
63 lines per minute (lpm); 120 characters per second (cps)
Interface: Parallel standard; serial optional
80 columns pica; 132 columns compressed; 40 columns expanded
Matrix: 9 × 9
Data-processing quality; italics; emphasized
True descenders; underlining, superscript/subscript; double-strike
Bidirectional
Optional Tractor: Adjusts from 4 in. to 9.5 in.

The Riteman matrix printer is a good personal computer printer and may be acceptable for light, small-business use. While the documentation is good for the experienced programmer, it is inadequate for the novice.

The 9 × 9 matrix yields a clear and well-formed character set with true descenders. Although the double-strike mode darkens the print, it doesn't create a correspondence-quality character. In the emphasized type mode, the spaces between the dots are filled to create an excellent correspondence-quality print. The print head is rated at 100 million characters. However, as with all printers, the user must realize that enhanced and double-strike modes "use up" these characters more rapidly. The black cartridge ribbon is easy to install.

The Riteman is capable of producing emphasized, double-strike, double-width, compressed, and italicized print. It also handles underlining, superscripts and subscripts. In the normal pica mode, it prints 80 columns wide. Expanded print is produced at 40 columns per line, and compressed at 132 columns per line. The super- and subscripts are relatively easy to read, except for the squashed "5", which could easily be misread.

The friction-feed feature allows the user to insert typing paper and letterhead. The optional tractor allows the user to print on even

narrower paper such as mailing labels, for example. The tractor adjusts from 4 inches to 9.5 inches.

The throughput rate is 63 lines per minute (lpm) or approximately one single-spaced page per minute (66 lines per page). The head is capable of printing 120 cps in normal mode or 60 cps in expanded or compressed mode. The bidirectional printing feature (printing in both directions, i.e., from left to right and from right to left) increases throughput; however, the printer does not have short-line-logic seeking. Short-line-logic seeking improves efficiency especially in situations where narrow columns are printed, for example, financial reports, mailing lists, and part-number listings. The throughput rate of 63 lpm is this printer's best speed.

When I attempted to make an original and three carbon copies, the head rubbed on the original and produced extensive streaking and a faint picture. The condition of the original was totally unacceptable. When I made a single carbon, both sheets were clean and legible.

Sometimes it's hard to install fan-fold paper with the tractor installed. The paper must be pushed by hand from the rear until it comes forward and up into the tractor pins. If the paper is not straight and stiff, it will hang on the plastic guard that protects the ribbon. I had to remove the tractor several times—which adds one more step to the operating process. Without the tractor, installing the paper is relatively easy.

The controls are easily reached and work well. However, I work with my printer at eye level and this places the Riteman switches out of sight, on top of the printer case. I had to stand up to operate the switches. LEDs (light-emitting diodes) indicate when the power is on, when the select is on, and when the paper is gone. A warning squeal tells the operator when the paper is out; however, the printer continues to print without it. This signal will not help the user who leaves the room during a printing operation.

DIP switches are conveniently placed behind a snap-out plastic cover on the back, allowing you to configure the printer to your application and select from four language fonts: USA, France, West Germany, and UK. The printer also has a self-test for (1) functional check of the control circuit; (2) functional check of the printer mechanism; (3) printed character quality check; and (4) self-test for printing.

Directions for set-up, operation, and maintenance are clear and

complete. However, directions for using the print codes are aimed at the hacker or programmer. For example, the instructions telling the user how to achieve double-strike, enhanced, or italicized modes, and for ending them, would be very difficult for a novice to understand. Neither a hacker friend of mine nor I were able to get the printer to single space.

Dealers and programmers will appreciate the many illustrations and examples of program statements that describe how to activate the print modes. A better description could have been written to tell the programmer how to exit from a print mode. The manual needs a table or chart that itemizes all control codes. (For example, the manual for the Okidata Microline 92 has an excellent chart for this purpose.)

The Riteman does not have a buffer memory, as indicated by the fact that stopping computer output results in the printer stopping immediately. The Centronics parallel port comes standard with the printer. A serial RS-232C port is optional.

The Riteman comes with a 90-day limited warranty on parts and labor. No toll-free 800 number is provided for service inquiries. In fact, no telephone number is listed in the manual.

SUMMARY

The Riteman is a good buy for the hobbyist and light-commercial user. Its price, portability, and relatively quiet operation are pluses. Aside from some aggravation in installing paper and in figuring out the control codes, the printer is acceptable.

IBM PERSONAL COMPUTER COLOR MATRIX PRINTER

International Business Machines Corp.
$1995

PERFORMANCE RATING
Performance: Good
Documentation: Good
Ease of Use: Novice - Fair to Poor; Programmer - Good
Usage: Commercial - Good

FEATURES
Print Speed: Draft quality: 200 characters per second (cps)
Text Mode: 100 cps
Near-Letter-Quality (NLQ): 35 cps
Colors: All black; 4-color: red, green, blue, black; 8-color: yellow, magenta, cyan, black, orange, green, violet, brown
Ribbon: Cartridge
Matrix: Draft quality - 8 × 9;
Text Mode: 24 × 9
Near-Letter-Quality (NLQ): 36 × 18
Line Graphics: 24 × 14
Dot-Addressable Graphics: 82.5 × 82.5 dots per inch (dpi)
Paper Width: 5 in. to 14.9 in. (132 characters at 10 cpi; 226 characters at 17.1 cpi)
Bidirectional, true descenders, underlining
Type Styles: Helvetica font: 10, 12, 16, 17.1 cpi; double width, superscript/subscript, proportional spacing, emphasized
Paper Feed: Tractor and manual single-sheet feed; Front, bottom, and back feed
Interface: IBM PC parallel
Buffer: 6K (multiple-line buffering)
Software: User diagnostic diskette; no driving software available from IBM at the time of this review
Dimensions: height 9 in. × width 21.6 in. × depth 12.5 in.
Weight: 36 lbs.
Options: Printer paper rack - $25

The IBM Color Matrix Printer is impressively built, operates quietly, and is fast. However, for the price, I expected higher quality color printing and some software support. During the demonstration the machine didn't do what it was supposed to do on a couple of occasions. Once the paper wrinkled and started to jam, and several times the colors separated.

In general, the print quality is excellent. However, some colors, such as yellow, don't show up very well. The near-letter-quality (NLQ) print is extremely good, though small, like elite type. The 17 cpi NLQ proportional print is really too small and compact to be read easily. In text- and data-processing quality 17 cpi is more legible.

An automatic band shift moves the black ribbon up and down to extend its life. The user needs special software to move the multicolored ribbon and mix the colors. Unfortunately, IBM did not provide this software at the time of this review. Other than the diagnostics disk, you're on your own. Custom programming is expensive and time consuming.

The front panel has membrane keys for controlling print mode, line spacing, form length, intercharacter spacing, margins, tabs, and auto underlining. The built-in tractor handles paper from 5 to 14.9 inches as well as single-sheet feed. However, the printer won't print addresses on envelopes.

The documentation is good, and the warranty covers one year.

SUMMARY

The IBM Color Matrix Printer produces acceptable eight-color printing and graphics. During the demonstration, the printer had several problems with paper feed and color separation. The print quality is good, though the NLQ 10 cpi print is small, like elite type. The printer is unable to feed and print envelopes. IBM provides no software support for the printer so the user will have to develop programs to operate it. The printer is ruggedly built and operates very quietly for a matrix printer. Nevertheless, at this price, the printer leaves a lot to be desired.

SPIRIT-80 MATRIX PRINTER

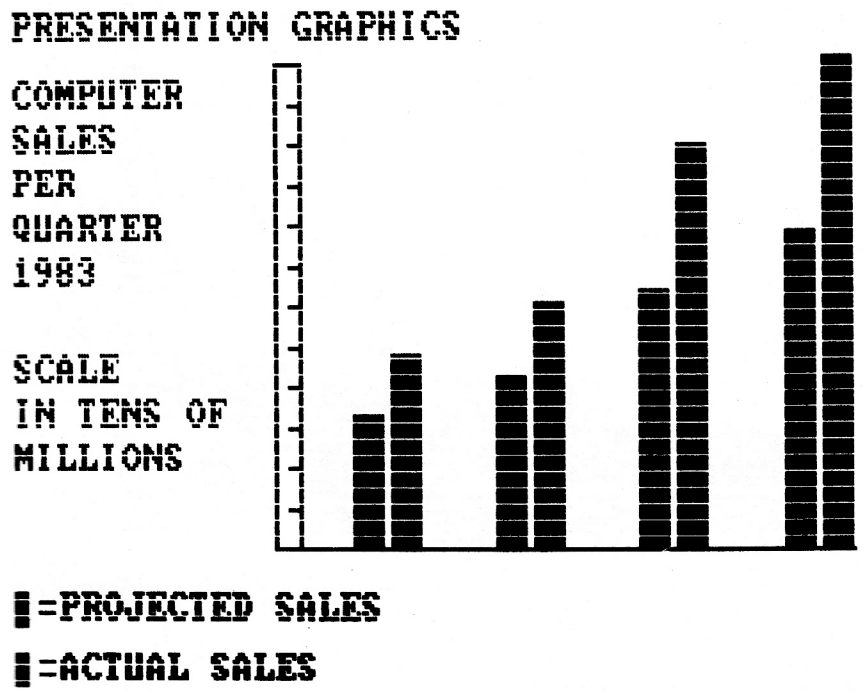
Mannesmann Tally
$399

PERFORMANCE RATING
Performance: Good
Documentation: Good
Ease of Use: Good
Usage: Home - Excellent; Light Commercial - Good

FEATURES
80 characters per second (cps)
Matrix: 9 × 8
640 dots/203.2 mm (8-inch line); 1280 dots/208.2 mm (compressed)
Print Styles: Pica, italic, pica bold, emphasized
Print Sizes: 5, 10, 12, 17 characters per inch (cpi)
Characters Per Line: Normal 80; double-width 40; double-width compressed 71; compressed 142
Bidirectional; short-line-logic seeking; true descenders
Graphics Mode: Unidirectional
Paper Feed: Friction; adjustable sprocket push
Paper Width: 4 in. to 10 in.
Ribbon: Cartridge
Indicators: LEDs - power on/off, ready, on/off line, paper out
Interface: Centronics parallel; RS-232C serial (optional)
Dimensions: height 5 in. × width 15 in. × depth 13 in.
Weight: 11 lbs.

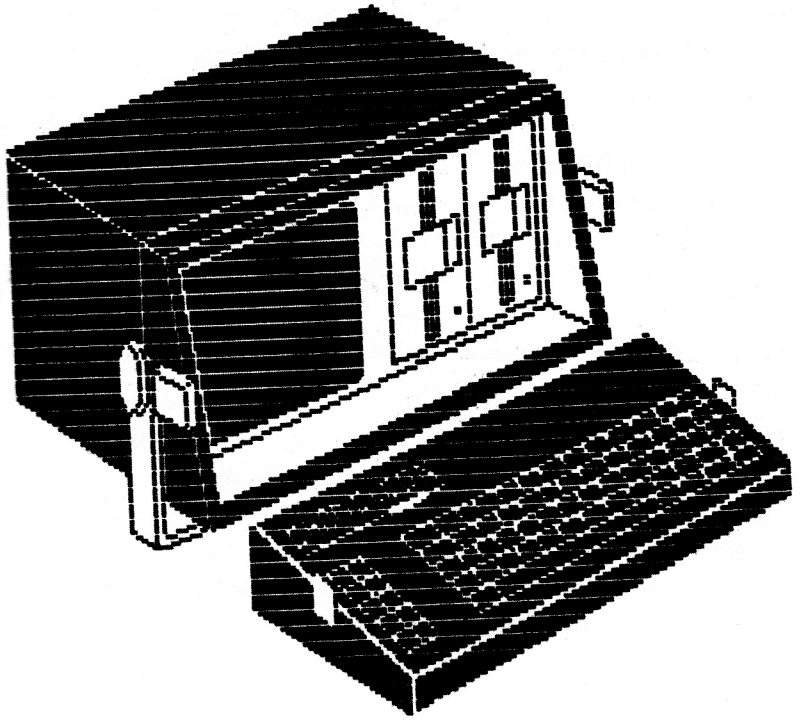
The Spirit-80 is an excellent, low-cost matrix graphics printer. Because of a unique impact-needle design, Mannesmann Tally achieves densely printed patterns in the graphics mode and clear, rounded characters in the print mode. The needles in the print head are square instead of round, as in most matrix printers. The square pin fills the spaces between one pin and the other better than round pins do. The only disadvantage to the graphics printing is that the printer leaves a small white (unprinted) horizontal line every 1/8th of an inch (vertical spacing). Actually, this isn't unpleasant, especially for graphs; but it isn't as good as the MPI Sprinter which, however, costs twice as much.

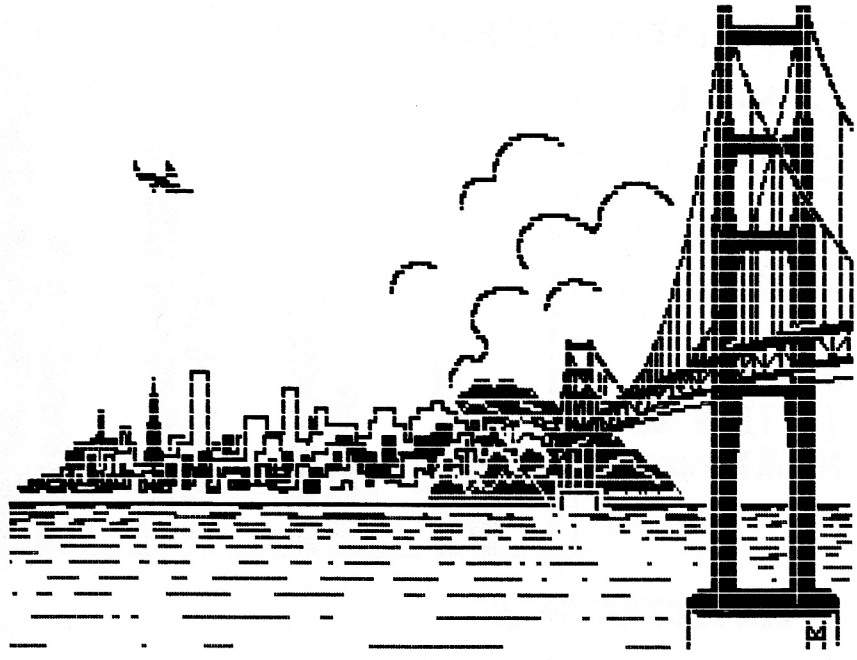
The print quality, even in the 80 cps data processing mode, is very good—similar to the Prowriter 8510. The double-strike mode approaches letter quality. The characters are rounded and resemble typewriter quality. The built-in, adjustable push tractor handles



Print Sample: Spirit-80 Printer. Courtesy of Mannesmann Tally

Print Sample: Spirit-80 Printer. Courtesy of Mannesmann Tally





Print Sample: Spirit-80 Printer. Courtesy of Mannesmann Tally

paper from 4-inch- to 10-inch-wide. The tractor pushes the paper through the print area and allows the user to tear off paper without waste.

The manual is short, but covers most of the information the user needs. Program listing samples and illustrations give even the novice good instructions for configuring the printer. To set the DIP switches the user must remove the complete case.

The Spirit-80 is not designed for heavy, continuous use. The high-resolution graphics mode should be used only occasionally. For home and light commercial use, the Spirit-80 is an excellent choice.

SUMMARY

The Spirit-80 is an excellent, light-duty matrix printer that produces excellent quality print and high-resolution graphics. Considering its price, the graphics are outstanding. The square pins in the head actually give characters a more rounded appearance than the more traditional round pins. The Spirit-80 is an excellent buy for home and light-commercial users.

MT 160L AND MT 180L MATRIX PRINTERS

Mannesmann Tally
Model MT 160L: $798; Model MT 180L: $1098

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Good
Usage: Commercial/Home - Excellent

FEATURES
160 characters per second (cps) data processing mode; 40 cps correspondence-quality mode
Continuous-duty cycle (operates nonstop)
Bidirectional; short-line-logic seeking
True descenders; proportional spacing; high-resolution graphics
Print Matrix: 7 × 9 - data processing quality; 20 × 18 - correspondence quality
64 × 50; 64 × 100; 64 × 67; 128 × 133 dots per inch in graphics mode
Character Density: 10, 12, 16.5, 20 characters per inch (cpi); 5, 6, 8.25, 10 cpi in double-width mode
Characters per Line: MT 160L - 80 at 10 cpi; 160 at 20 cpi
MT 180L - 132 at 10 cpi; 264 at 20 cpi
Character Sets: Seven; MT 180L - 31 resident scientific characters
Paper Handling: Friction; optional tractor and roll holder
Paper Size: MT 160L - 3 in. to 10 in.; MT 180L - 3 in. to 16 in.
Controls: Membrane switches - test, on/off line, yes/no, line feed/form feed
Ribbon: Cartridge
Interface: Both Centronics parallel and RS-232C serial
Baud Rate: Up to 9600 in serial
Dimensions: MT 160L - width 13.7 in. × depth 9.7 in. × height 6.2 in.
MT 180L - width 19.1 in. × depth 9.7 in. × height 6.1 in.
Weight: MT 160L - 17 lbs.; MT 180L - 23 lbs.

The Mannesmann Tally Models MT 160L and 180L offer unusually good printing and graphics capabilities. The heavy-duty construction enables these printers to perform continuously—24 hours per day. The draft-quality print at 160 cps is quite legible; but has a distinctive dot pattern. In contrast, the less expensive Spirit-80 produces near-correspondence quality in the single-strike mode at 80 cps. For high-speed throughput and continuous duty, though, the MT 160 and 180 are much better than the Spirit-80. In the double-

strike mode, the print quality is quite good, though not consistent enough to pass as typewriter quality. The MT 160 and 180 produce superb graphics in black on white or white on black. The throughput rate drops dramatically for boldface and correspondence quality.

Setting up the printer is quite easy. Most people will just plug it in and begin printing. However, those who want to custom configure the default settings stored in nonvolatile memory will appreciate the menu-driven set-up program. Some of the choices available include: form length, lines per inch, characters per inch, pitch, and character set. Pressing the Yes/No keys on the front panel enters the desired settings in response to printed questions.

The noise level is fairly typical of matrix printers. The user inserts paper as in a typewriter. The optional tractor feed can be installed in less than a minute.

The documentation assumes some computer expertise. The manual is well illustrated and printed. Set-up instructions are clearly written. However, the sections that describe how to program graphics are brief and, in some places, incomprehensible.

Mannesmann Tally warranties the unit for 90 days and the print head for the equivalent of 12 months. This machine is built for heavy use. A local dealer told me that he's had no service calls on these units for six months.

SUMMARY

The Mannesmann Tally MT 160 and 180 printers are excellent for continuous duty and graphics applications. The rugged construction should give trouble-free service for a long time. The print quality in draft mode is good, and in correspondence quality very good—though it is not of typewriter quality. The high-resolution graphics are excellent; but, the documentation won't help the novice figure out how to achieve them. The service record on these units is excellent.

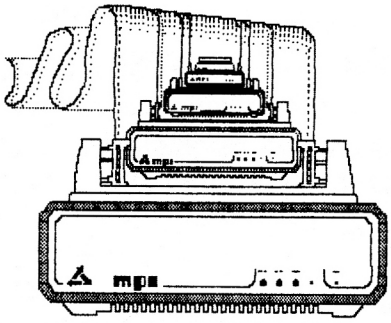
PRINTMATE 150 MATRIX PRINTER

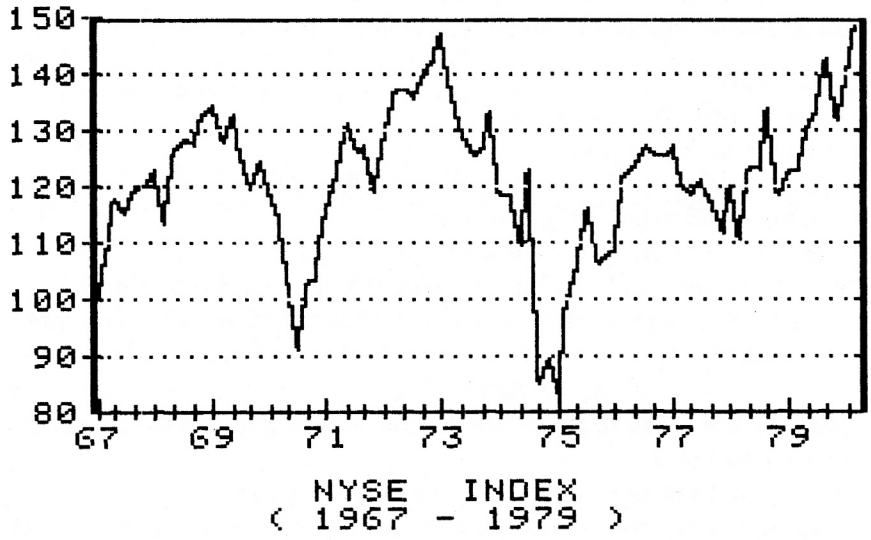
Micro Peripherals, Inc.
Model A - Without SoftSwitch Keypad: $1045; Model B - With SoftSwitch Keypad: $1150

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home - Excellent; Small Commercial - Excellent

FEATURES
150 characters per second (cps)
Bidirectional; logic seeking
10 cpi/136 columns; 12 cpi/163 columns; 15 cpi/204 columns; 17 cpi/231 columns and expanded print fonts
Matrix: 7 × 9 draft; 11 × 9 correspondence quality
True descenders, underlining, double-width, and emphasized print
Character Sets: 3 selectable foreign fonts; 136 to 231 columns, depending on pitch
Buffer: 4K standard, expandable to 68K
SoftSwitch Keypad (option): Sets fonts, tabs, form length, baud rate, print density, etc.
Paper Feed: Built-in friction and tractor feed; bottom
Paper Size: Cut sheet - Maximum 15 in.; Fanfold - 3 in. to 15 in. (incl. sprocket)
Ribbon: Continuous loop cartridge
Controls: Power on/off, paper advance, top of form set/feed, on/off line, form feed, self-test, optional 12-key front panel programming pad with nonvolatile memory and audible-tone feedback
Indicators: Power on, ready, select
Interface: Centronics parallel; RS-232C serial; IEEE-488
Graphics: High resolution dot-addressable
Vertical - 72 dots per inch (dpi); Horizontal - 50, 60, 72, 80 or 85 dpi
Dimensions: width 23 in. × depth 15.7 in. × height 7.5 in.
Weight: 25 lbs.
Options: Front and rear paper guides; printer stand with paper basket

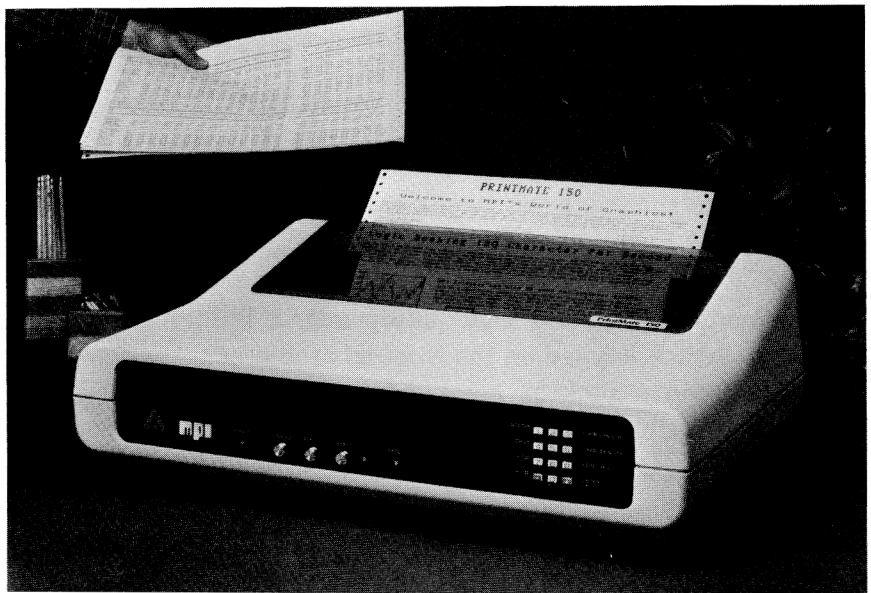
The PrintMate 150 is a high-quality matrix printer. The convenient SoftSwitch keypad on the front lets the user set and save default instructions such as baud rate, form length, vertical tabs, horizontal tabs, and margins.





Print Samples: PrintMate 150. Courtesy of Micro Peripherals, Inc.

PrintMate 150. Courtesy of Micro Peripherals, Inc.



Pushing the button causes the printer to display the current setting. Further pressing displays the other options available. Once the user selects the desired setting, the PrintMate 150 responds with a cute chime. The default settings are stored in a nonvolatile memory that remains intact even when the unit is unplugged from AC power.

The bottom feed automatically moves the paper to the top of the form. The PrintMate 150 comes standard with both friction and tractor feeds. The tractor adjusts to handle mailing labels as narrow as 3 inches.

The character print quality is very good and the graphics print quality excellent. The printer seemed a bit loud compared to other matrix printers. The noise would interfere with telephone conversations in an office.

The manual isn't fancy, but it does contain most of the information that an experienced user requires. The manual isn't complete enough for the novice. A two-page table of contents directs the user to the desired instructions. Almost every page has a chart, diagram, or example. Instructions for removing and installing the ribbon cartridge are printed on the cartridge. The power cable must be attached inside the printer case.

Micro Peripherals provides an additional AP-PAK interface and software for printing graphics and special fonts. I recommend these for graphics applications. The Apple AP-PAK package costs $155.

SUMMARY

The PrintMate 150 matrix printer produces good draft printing and excellent graphics. The SoftSwitch keypad on the front panel offers easy selection and permanent storage of default printing instructions. The built-in friction and tractor feeds enable the printer to handle single-sheet and continuous-form printing applications. The optional AP-PAK interface and software package makes graphics printing easy and efficient.

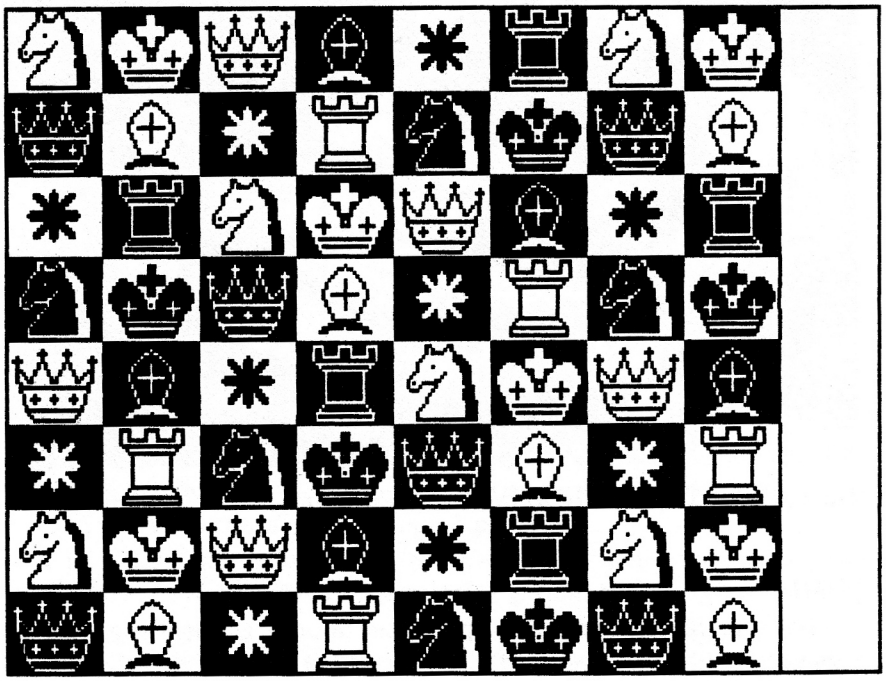
SPRINTER PORTABLE MATRIX PRINTER

Micro Peripherals, Inc.
Without SoftSwitch Keypad: $795; With SoftSwitch Keypad: $870

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home - Excellent; Small Commercial - Good

FEATURES
160 characters per second (cps)
Bidirectional
10, 12, 14.4, 15, and 17 characters per inch (cpi)
Expanded Print: 5, 6, 7.2, 7.5, and 8.5 cpi
Matrix: 7 × 9 draft; 11 × 9 correspondence quality
80 to 136 columns, depending on pitch
True descenders, underlining, emphasized print
Character Sets: 5, including correspondence quality
Buffer: 4K standard, expandable to 68K
SoftSwitch Keypad (option): Sets fonts, tabs, form length, baud rate, print density, etc.
Paper Feed: Built-in friction and tractor feed; front/rear
Paper Size: Cut sheet - Maximum 9.5 in.; Fanfold - 3 in. to 9.5 in. (incl. sprocket)
Ribbon: Continuous loop cartridge
Controls: Power on/off, paper advance, top of form set/feed, on/off line, form feed, self-test, optional 12-key front panel programming pad with nonvolatile memory and audible tone feedback
Indicators: Power on, ready, on-line
Interface: Centronics parallel; RS-232C serial; IEEE-488
Graphics: High-resolution, dot-addressable
Vertical - 72 dots per inch (dpi); Horizontal - 50, 60, 72, 80, or 85 dpi
Dimensions: width 18 in. × depth 14.5 in. × height 7 in.
Weight: 16 lbs.

The Sprinter is a compact, high-quality portable matrix printer. By snapping on a top, the user turns the molded housing into a carrying case. The convenient SoftSwitch keypad on the front lets the user set and save default instructions such as baud rate, form length, vertical tabs, horizontal tabs, and margins. Pushing the button causes the printer to display the current setting. Pressing the button again displays the other available options. Once the user selects the



High Resolution Print Sample: Sprinter. From *GHESS: A Logical/Deduction Game Based on Chess Moves.* Courtesy of Gary J. Bullard, author

desired setting, the Sprinter responds with a chime. The default settings are stored in nonvolatile memory that remains intact even when the unit is unplugged from AC power.

The printer accepts paper from the top and front. The front feed automatically moves the paper to the top of the form. The Sprinter comes standard with both friction and tractor feeds. The tractor adjusts to handle mailing labels as narrow as three inches.

The character print quality is very good and the graphics print quality excellent. The printer seemed a bit loud compared to other matrix printers. The noise would interfere with telephone conversations in an office.

The manual isn't fancy, but does contain most of the information the user requires. A two-page table of contents directs the user to the desired instructions. Almost every page has a chart, diagram, or example. Instructions for removing and installing the ribbon cartridge are printed on the cartridge.

Micro Peripherals provides an additional AP-PAK interface and software for printing graphics and special fonts. I recommend these for graphics applications. The Apple AP-PAK package costs $155.

The Sprinter. Courtesy of Micro Peripherals, Inc.

SUMMARY

The Sprinter matrix printer produces good draft printing and excellent graphics. The portability is an added plus for traveling computer users. The SoftSwitch keypad on the front panel offers easy selection and permanent storage of default printing instructions. The easy-to-load front feed makes single-sheet feeding a snap. Built-in friction and tractor feeds enable the printer to handle single-sheet and continuous-form printing applications. The optional AP-PAK interface and software package makes graphics printing easy and efficient.

The Sprinter and Carrying Case. Courtesy of Micro Peripherals, Inc.

MICROLINE 92 MATRIX PRINTER

Okidata Corp.
$699

PERFORMANCE RATING
Performance: Excellent
Documentation: Good
Ease of Use: Good
Usage: Home - Excellent; Light Commercial - Good

FEATURES
Speed: 160 characters per second (cps) - Draft mode; 80 cps - Enhanced/emphasized mode; 40 cps - Correspondence-quality mode
80 columns at 10 characters per inch (cpi)
Matrix: 9 × 9 data processing matrix; 9 × 17 correspondence-quality matrix; 60 × 72 or 72 × 72 dot-addressable graphics
True descenders
Compressed and expanded print; Correspondence-quality/dual-pass print
Bidirectional, short-line-logic seeking
Paper Feed: Friction, pin, and optional tractor
Paper Path: Rear/bottom
Paper Size: 8.5 in. friction; 9.5 in. pin or tractor; Tractor adjustment 3 in. to 9.5 in.
Interface: Centronics parallel or RS-232C serial
Buffer: 2K
Ribbon: Spool
Dimensions: width 14 in. × depth 13 in. × height 5 in.
Weight: 20 lbs.

The Okidata Microline 92 is a flexible small-business and personal computer printer. The data processing printing mode provides moderate-speed printing while the dual pass correspondence-quality mode provides a high-quality, dense matrix pattern with true descenders. Data processing quality is printed at 160 cps with bidirectional and short-line-logic seeking. The correspondence-quality mode requires the printer to pass over the same line twice and thus slows the speed to 40 cps.

Although the carriage width only allows 80 columns at 10 characters per inch (cpi), the ability to reduce font size to 12 and 17 cpi allows the user to print 96 and 136 columns, respectively. The double-width or expanded mode stretches out characters for headings

and emphasized print. Correspondence-quality modes are available for all fonts except the 17 cpi, which is dense enough already.

Documentation Is a Big Plus

Not only is the manual clear and complete, but Okidata provides a toll-free number for user assistance: 1-800-OKI-DATA. Although the manual attempts to define terms, the definitions assume that the reader already knows what the terms mean. Each printer feature is enumerated and defined so the user knows what the printer capabilities are.

Attractive Features

The user can create a unique character set with the Microline 92 printer. Thus graphics and other special uses are possible. Three font sizes, double-width characters, emphasized and enhanced printing, superscripts and subscripts, continuous underlining, variable paper-length settings, horizontal tabulator, variable lines per inch (6 and 8 cpi), and a self-test function increase the worth of this printer.

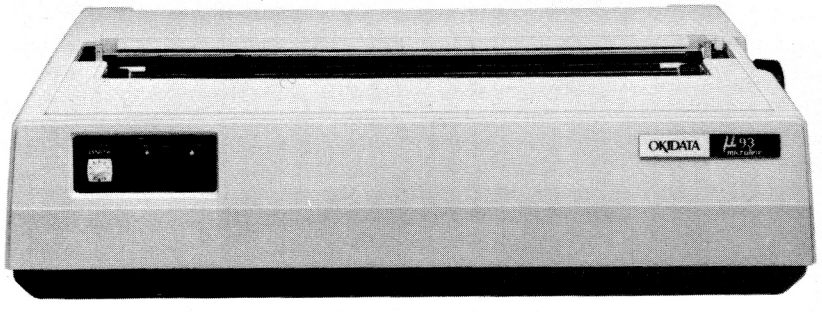
The printer comes with both a pin and friction paper feed. An optional tractor is available for $50; however, the tractor, which adjusts from 3 to 9.5 inches, seriously interferes with theading the paper through the platen. The tractor does not allow the pressure bar that holds the paper against the platen to be raised more than a fraction of an inch. This makes inserting paper and aligning it on the tractor a bit tricky, though not impossible. I discovered that the paper for labels must be moved to the right about 1/2 inch so that the paper roller hold-down will not interfere with the tractor-feed bracket. This gives adequate clearance for the labels to move past the paper roller hold-down bar, without peeling the labels off the backing. Some design or procedure changes are indicated here. The pin feed crinkles a number 10 envelope on each margin.

Like most impact printers, the Microline 92 is a bit noisy. Its small profile and ability to feed paper from both the bottom and the rear make it both convenient to install and portable.

With an estimated mean-time-between-failures rating of 4000 hours and a print head life of 200 million characters, the printer is well suited to home and small-business applications.

The Microline 92 ribbon threads through the mechanism like an old-style typewriter. (Plastic gloves would be desirable but are not supplied by Okidata.)

Microline 92



Microline 93

Okidata Microline 92 and 93. Courtesy of Okidata Corp.

Although the manual clearly explains how to invoke the commands to change font size, to underline, and so on, some users may have to key in 16 control codes to enter and exit a mode. For example, to achieve underlining the user must enter ^01B^043 before and ^01B^044 after the text to be underlined. To fully utilize the printer's

versatile modes, a new user would have to post a "cheat sheet" above the terminal in order to remember these commands.

The 9 × 9 dot-matrix print head pattern creates a 9 × 17 dot-density pattern in the dual-pass mode. The correspondence-quality print looks more like letter quality than do competitive brands. The Microline 92 character set is more pleasing to the eye due to the design or configuration of the characters, which have a more rounded appearance. For example, the "o" is not as staggered as those produced by many other matrix printers.

SUMMARY

The competitively priced Microline 92 matrix printer offers a multitude of features and benefits for the home and small-business user. The documentation is adequate. The printer is portable, occupies little space, and is easy to install.

MICROLINE 93 MATRIX PRINTER

Okidata Corp.
$1249

PERFORMANCE RATING
Performance: Excellent
Documentation: Good
Ease of Use: Good
Usage: Home - Excellent; Light Commercial - Excellent

FEATURES
160 characters per second (cps) - Draft mode
Speed: 80 cps - Enhanced/emphasized mode; 40 cps - Correspondence-quality mode
136 columns at 10 characters per inch (cpi)
Matrix: 9 × 9 data processing matrix; 9 × 17 correspondence-quality matrix; 60 × 72 or 72 × 72 dot-addressable graphics
True descenders
Compressed and expanded print; Correspondence-quality/dual-pass print
Bidirectional, short-line-logic seeking
Paper Feed: Friction, pin, and optional tractor
Paper Path: Rear/bottom
Paper Size: 15 in. friction; 16 in. pin or tractor; Tractor adjustment 3 in. to 16 in.
Interface: Centronics parallel or RS-232C serial
Buffer: 2/4K
Ribbon: Spool
Dimensions: width 20 in. × depth 13 in. × height 5 in.
Weight: 31 lbs.

The Okidata Microline 93 is a flexible small-business and personal computer printer. The data processing printing mode provides moderate-speed printing while the dual-pass correspondence-quality mode provides a high-quality, dense matrix pattern with true descenders. Data processing quality is printed at 160 cps, with bidirectional and short-line-logic seeking. The correspondence-quality mode requires the printer to pass over the same line twice, and thus slows the speed to 40 cps.

The carriage width allows 136 columns at 10 characters per inch (cpi), and the ability to reduce font size to 12 to 17 cpi allows the user to print 163 and 233 columns, respectively. The double-width or

expanded mode stretches out characters for headings and emphasized print. Correspondence-quality modes are available for all fonts except the 17 cpi, which is dense enough already.

Documentation Is a Big Plus

Not only is the manual clear and complete, but Okidata provides a toll-free number for user assistance: 1-800-OKI-DATA. Although the manual attempts to define terms, the definitions assume that the reader already knows what the terms mean. Each printer feature is enumerated and defined so the user knows what the printer capabilities are.

Attractive Features

The user can create a unique character set with the Microline 93 printer. Thus graphics and other special uses are possible. Three font sizes, double-width characters, emphasized and enhanced printing, superscripts and subscripts, continuous underlining, variable paper-length settings, horizontal tabulator, variable lines per inch (6 and 8), and a self-test function increase the worth of this printer.

The printer comes with both a pin and friction paper feed. An optional tractor is available. However, the tractor, which adjusts from 3 to 16 inches, seriously interferes with threading the paper through the platen. The tractor does not allow the pressure bar that holds the paper against the platen to be raised more than a fraction of an inch. This makes inserting paper and aligning it on the tractor a bit tricky, though not impossible. I discovered that the paper for labels must be moved to the right about 1/2 inch so the paper roller hold-down will not interfere with the tractor-feed bracket. This gives adequate clearance for the labels to move past the paper roller hold-down bar, without peeling the labels off the backing. Some design or procedure changes are indicated here.

Like most impact printers, the Microline 93 is a bit noisy. Its small profile and ability to feed paper from both the bottom and the rear make it convenient to install.

With an estimated mean-time-between-failures rating of 4000 hours and a print head life of 200 million characters, the printer is well suited to home and small-business applications.

The Microline 93 ribbon threads through the mechanism like an old-style typewriter. (Plastic gloves would be desirable but are not supplied by Okidata.)

Although the manual clearly explains how to invoke the commands to change font size, to underline, and so on, some users may have to key in sixteen control codes to enter and exit a mode. For example, to achieve underlining the user must enter ^01B^043 before and ^01B^044 after the text to be underlined. To fully utilize the printer's versatile modes, a new user would have to post a "cheat sheet" above the terminal in order to remember these commands.

The 9 × 9 dot-matrix print head pattern creates a 9 × 17 dot-density pattern in the dual-pass mode. The correspondence-quality print looks more like letter quality than do competitive brands. The Microline 93 character set is more pleasing to the eye due to the design or configuration of the characters, which have a more rounded appearance. For example, the "o" is not as staggered as those produced by many other matrix printers.

SUMMARY

The competitively priced Microline 93 matrix printer offers a multitude of features and benefits for the home and small-business user. The documentation is adequate and the printer is easy to use and install.

GEMINI-10X DOT-MATRIX PRINTER

Star Micronics, Inc.
$390

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Novice - Fair; Hacker - Good
Usage: Home and Small Commercial - Good

FEATURES
120 characters per second (cps)
Bidirectional; logic seeking
Friction and tractor feed, standard
10-in. carriage
Character Pitch: 5, 6, 8.5, 10, 12, 17 cpi
Columns: 80, 96, 136 (depending on pitch)
Paper Width: Roll 8.5 in. to 10 in.; cut sheet 8.3 in. to 10 in.; fanfold 3 in. to 10 in.
Multiple Copies: Up to 3 carbonless sheets
Print Buffer: 816 characters (optional 4K or 8K)
Ribbon: Two spools (reversible)
9-wire impact dot-matrix print head
Character Matrix: 9 × 9 standard with true descenders; 18 × 9 emphasized; 18 × 18 double strike; 240 × 144 ultra-high resolution; bit-mapped graphics
Character Sets: 96 standard ASCII; 96 italics; 64 special; 32 block graphics; 96 downloadable; superscript/subscript
Dimensions: width 13 in. × depth 12.5 in. × height 6 in.
Weight: 15.4 lbs.

There isn't much that the Gemini-10X dot-matrix impact printer can't do and do well. The print quality is quite clear—approaching letter quality in the double-strike mode. The characters have a more rounded quality than do many matrix printers. The Gemini can certainly stand alongside the Epson and Okidata.

The characters seem to have a narrower profile, which leaves more blank space between the characters, and improves legibility. The small superscript and subscript print is quite easy to read.

The Gemini is capable of handling fan-fold, single-sheet, and roll paper. In addition to a bail for catching tractor-fed paper, the printer comes with a holder for roll paper, which is much less expensive.

The Gemini comes standard with both tractor and friction paper feed. The tractor mechanism adjusts between 3 and 10 in. wide and is easily removed. The Gemini doesn't print envelopes or single labels conveniently.

The Underwood-style ribbon must be threaded through the mechanism between two spools. Like the old-fashioned typewriter ribbon, the spools may be turned over so the printer can type on a fresh ribbon strip. The ribbons cost about $5 each.

The warranty is 90 days on the print head and 180 days on the rest of the machine. The print head is user-replaceable when it wears out.

Once you get the printer set up and configured to your computer system, you'll really like it. Unfortunately, the printer comes from the dealer with an abbreviated user's manual only. The full manual is mailed to the user several weeks later. The DIP-switch-setting instructions are rather confusing and may frustrate novices. See if you can borrow or copy the store's more complete manual. The full documentation is excellent.

SUMMARY

The Gemini-10X printer is an excellent, versatile, impact dot-matrix printer. The complete documentation is excellent; however, the manual arrives in the mail several weeks after purchase. At 120 characters per second (80 cps average), this printer is best suited for home and small-business users. The printer has a wide variety of print styles and sizes, and should fit almost any user's needs.

GEMINI-15X DOT-MATRIX PRINTER

Star Micronics, Inc.
$549

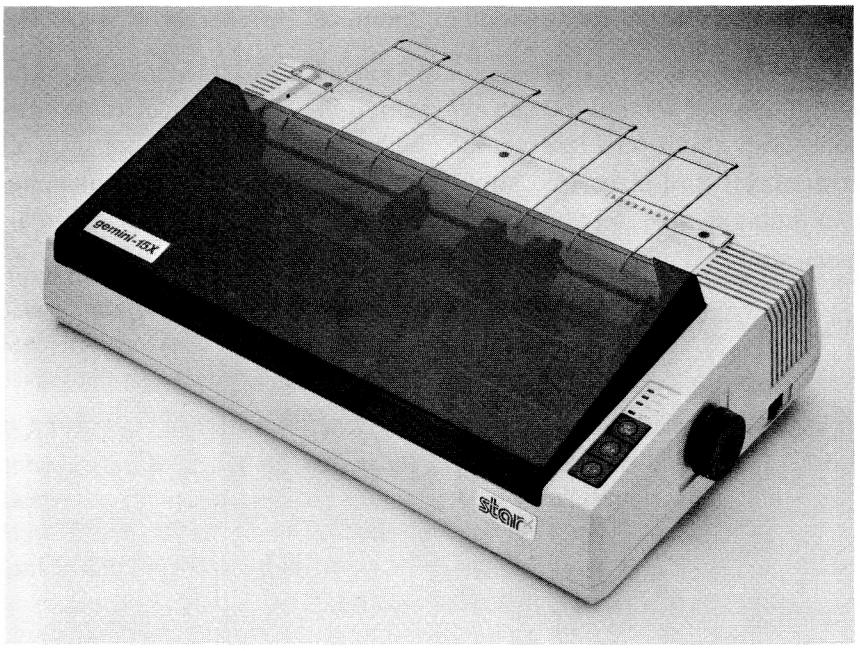
PERFORMANCE RATING
Performance: Good
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Novice - Fair; Hacker - Good
Usage: Home and Small Commercial - Good

FEATURES
120 characters per second (cps); bidirectional; logic seeking
Friction and tractor feed, standard
15.5 in. carriage
Columns: 136, 164, 232 (depending on pitch)
Character Pitch: 5, 6, 8.5, 10, 12, 17 cpi
Paper Width: Roll 8.5 in. to 15 in.; cut sheet 8.5 in. to 15 in.; fanfold 3 in. to 15.5 in.
Multiple Copies: Up to 3 carbonless sheets
Print Buffer: 816 characters (optional 4K or 8K)
Ribbon: Two spools (reversible)
9-wire impact dot-matrix print head
Character Matrix: 9 × 9 standard with true descenders; 18 × 9 emphasized; 18 × 18 double strike; 240 × 144 ultra-high resolution; bit-mapped graphics
Character Sets: 96 standard ASCII; 96 italics; 64 special; 32 block graphics; 96 downloadable; superscript/subscript; 88 international
Paper Feed: Bottom
Dimensions: width 21.3 in. × depth 12.5 in. × height 5.5 in.
Weight: 22 lbs.

There isn't much that the Gemini-15X dot-matrix impact printer can't do and do well. The print quality is quite clear—approaching letter quality in the double-strike mode. The characters have a more rounded quality than do many matrix printers. The Gemini can certainly stand alongside the Epson and Okidata.

The characters seem to have a narrower profile, which leaves more blank space between the characters, and improves legibility. The small superscript and subscript print is quite easy to read.

The Gemini is capable of handling fan-fold, single-sheet, and roll paper. In addition to a bail for catching tractor-fed paper, the printer comes with a holder for roll paper, which is much less expensive. The Gemini comes standard with both tractor and friction paper



Gemini-15X Dot-Matrix Printer. Courtesy of Star Micronics, Inc.

feed. The tractor mechanism adjusts to between 3 and 15.5 in. wide and is easily removed. The wider carriage permits printing up to 136 columns in 10 cpi for financial reports. The 15X also offers bottom paper-feed. The Gemini doesn't print envelopes or single labels conveniently.

The Underwood-style ribbon must be threaded through the mechanism between two spools. Like the old-fashioned typewriter ribbon, the spools may be turned over so that the printer can type on a fresh ribbon strip. The ribbons cost about $5 each.

The warranty is 90 days on the print head and 180 days on the rest of the machine. The print head is user-replaceable.

Once you get the printer set up and configured to your computer system, you'll really like it. Unfortunately the printer comes from the dealer with an abbreviated user's manual only. The full manual is mailed to the user several weeks later. The DIP-switch-setting instructions are rather confusing and may frustrate novices. See if you can borrow or copy the store's more complete manual. The full documentation is excellent.

SUMMARY

The Gemini-15X printer is an excellent, versatile, impact dot-matrix printer. The complete documentation is excellent; however, the

manual arrives in the mail several weeks after purchase. At 120 characters per second (80 cps average), this printer is best suited for home and small-business users. The printer has a wide variety of print styles and sizes and should fit almost any user's needs. The 15.5 inch carriage is better suited than the 10X to business applications that may require printing wider-column financial reports.

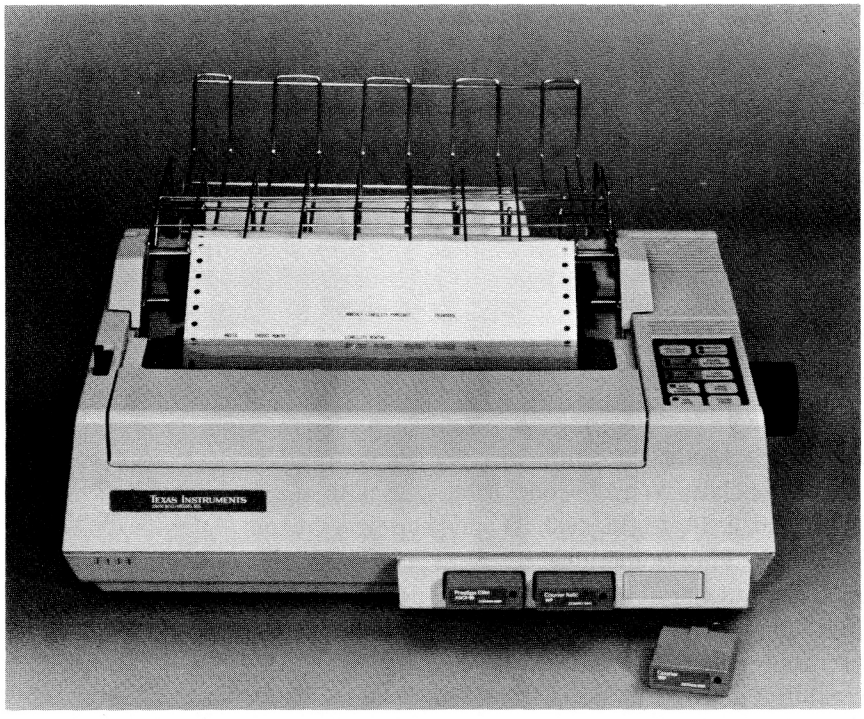
OMNI 800 MODEL 855 MATRIX/ELECTRONIC DAISY WHEEL PRINTER

Texas Instruments
$935

PERFORMANCE RATING
Performance: Good
Documentation: Excellent
Ease of Use: Good
Usage: Home - Good; Small Business - Good/Fair

FEATURES
Dot-Matrix Mode: 150 characters per second (cps); 9 × 9 matrix
Electronic Daisy Wheel Mode: 35 cps; 32 × 18 matrix
Print Size: 5, 10, 12, 15, 16.5, 20 cpi; proportional spacing
Font Style: Plug-in modules
Special Print Capabilities: True descenders, overstrikes, underlining
Characters per Line: 80, 96, 120 (depending on pitch)
Friction feed
Tractor: 3 in. to 11 in. paper (optional)
Paper Size: 3 in. to 11 in.
Ribbon: Cartridge
Carbon Copies: 2 (rated for 3)
Interface: Parallel or serial
Baud Rate: 9600
Buffer: 256 characters (optional 4K)
Dimensions: width 15.5 in. × depth 13 in. × height 5 in.
Weight: 15 lbs.

The TI Model 855 matrix printer is the only matrix printer I've found that produces typewriter-quality print. I'm not talking about the correspondence or double-strike quality produced by most matrix printers—most people can't tell that an OMNI 855-printed document was printed by a matrix printer. Not only that, the plug-in modules that resemble computer game cartridges allow you to change font style with software control or the push of a button. You can even print an italicized word in the middle of a sentence. The font modules include Courier, Courier Italic, Prestige, Elite, Orator, Gothic, Modern Proportional, foreign language alphabets, and scientific and mathematical characters. I was a bit disappointed in the quality of the data processing-quality print. It doesn't measure up to that produced by relatively inexpensive printers such as the Gemini-10X. The TI 855 underlines very slowly.



Texas Instruments OMNI 800 Printer. Courtesy of Texas Instruments

TI advertises that the versatility of this printer makes it possible for the user to have one printer that serves both data processing (rapid speed) and letter-quality needs. For straightforward printing operations, this is true. Unfortunately, this printer has some drawbacks for normal business use. I found that printing envelopes, shipping labels, and multiple copies was difficult, if not impossible. Feeding an envelope into the friction roller was difficult. The envelope tended to slip, and, if it wasn't positioned on the far left, the out-of-paper trip deactivated the printer. As the envelope was inserted, the print head streaked the paper. I couldn't feed single shipping labels into the mechanism at all. If I tried to put in my letter head, one sheet of carbon, and a second sheet, they would frequently hang under the roller or on the print head and crease the top of the paper. If I put more than one carbon in, the print head streaked my original and made a mess.

The clear plastic cover that protects the print mechanism opens from front to back—it hinges near the platen. This configuration causes interference between the back edge of the cover and the paper, and makes paper alignment awkward.

The documentation is the best I've seen. The operator's manual and technical reference manual are well referenced, illustrated, and indexed. I can't imagine that anyone would have a question that the manuals couldn't answer—except the terms of the warranty, which aren't covered.

The plug-in, type font modules are wonderful. A green LED on the face of each of the three modules lights up to indicate the module selected. A membrane switch on top of the printer allows the user to select the desired module and print style. If necessary, software commands can switch modules in the middle of a sentence. I tested the Courier, Italic, and Gothic. The Italic had fewer characters per inch than the Gothic, so I had to adjust my margin settings when I switched from one to the other.

The membrane switches are inconveniently located on the top of the printer. I had to stand up to see them. Each switch has an LED to indicate which mode it's set in. The user can select the module (print style), draft, or letter quality, character spacing, line spacing (single or double at 6 or 8 lines per inch), form length, line feed, form feed, and on/off line. A red-alert LED warns when the paper is gone. Using these switches is simple and straightforward, except for the set-form-length, which sent me to the manual for help.

SUMMARY

The TI OMNI 800 Model 855 matrix printer produces excellent letter-quality print—the best I've seen from a matrix printer. The data processing quality print is average. The plug-in modules allow the user to change font styles with a switch, or by software control, anywhere in the text. Although it is advertised as a printer that serves all office needs, it did not satisfactorily print envelopes, individual mailing labels, or multiple copies. The documentation is among the best available.

Letter-Quality Printers

BROTHER HR-1 LETTER-QUALITY PRINTER

Brother International Corp.
$1225

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Good; Hacker - Excellent
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Small Commercial - Good; Home - Excellent

FEATURES
Daisy wheel letter-quality print head
23 characters per second (cps)
Bidirectional
Print Size: 10, 12, and 15 characters per inch (cpi); Proportional spacing
Two-color and bold print
110 characters per line at 10 cpi
Paper Width: 13.5 in.
Original plus 3 carbon copies
Centronics parallel interface, standard; RS-232C serial, optional
Memory Buffer: 3K (additional 2K, optional)
Noise Level: 65 dBA
Weight: 19.6 lbs.
Keyboard: Optional

The home or small-commercial user who requires letter-quality print may want to give the HR-1 serious consideration. With a print speed of 23 cps, this is a relatively slow printer. However, if there is no rush to complete printing or if it is used with a memory buffer, this printer is a good-performing, durable unit. The HR-1 is essentially the same printer as the Brother HR-15, with one key enhancement: It is equipped with a linear motor drive that is more precise and much stronger. This design requires fewer parts and thus should not wear out as fast as some other mechanisms. The HR-1 is suitable for light to medium commercial use, but not continuous printing applications.

This printer produces many special printing effects: two color, bold, auto double-strike, auto underline, superscript, subscript, proportional spacing, and graphics printing. In addition, an optional

plug-in keyboard turns this printer into a typewriter with an automatic correcting key. The memory buffer offers the ability to reprint text. That is, if the user wants duplicate copies of a document, pressing the COPY button will print two copies of the document, provided it is small enough to be stored in the buffer (3K buffer = 3000 characters; 5K buffer = 5000 characters).

The bidirectional print head movement enhances printing efficiency. An impression control allows the user to vary the impact hammer's striking pressure, depending on the number of carbon copies being produced. Differential striking produces even-quality print by using less force for the smaller surface area characters (period, comma, i) and more force for the larger surface area characters (m, w, s). This feature also prevents the daisy wheel from puncturing the paper.

Print wheels are available in twelve print styles for fifteen different languages (143 configurations). Print wheels cost $25 (foreign, $40.50), which seems a bit high compared with a Diablo wheel, which costs $10 to $12. The manual lists the print wheels available and their part numbers.

The print quality is very good. However, in the 15 cpi mode the letters touch each other and are a bit difficult to read. The HR-1 produces single-, one-and-one-half-, and double-spaced text.

The cassette ribbon cartridge see-through window helps the user determine how much ribbon is left on the spool.

Attractive Options

Other options available include a tractor feed and auto cut-sheet feeder. The tractor feed fits 12-in.-wide paper and costs $120. The cut-sheet feeder works with a maximum paper width of 8.5 in. and has a capacity of 150 sheets. The sheet feeder costs $250.

Plug-In Keyboard

The $195 touch-quality keyboard is an attractive option. Often, using a word processor to fill out forms and do simple tasks such as addressing envelopes is cumbersome. The typewriter-mode option may be just the thing for some users. Plugging the keyboard into the printer shuts off the input from the computer.

Easy Operation

Membrane switches on the front panel allow the user to copy text in the buffer, change the character pitch, adjust the vertical spacing, move the platen to the top of the form, and to line feed. Indicator

lights show whether the power is on, the audible alarm is activated, and the copy function is on. Lamps also indicate which print pitch and line pitch is selected. The audible alarm signals the end of the ribbon, when the paper is out (tractor feed only), and when the cut-sheet feeder is empty.

Good Documentation Is a Plus

The 46-page manual plus an 11-page update tell the whole story—clearly written, they discuss each operation. The table of contents directs the user to the proper section; however, the manual lacks an index.

It gives good detail on specifications, control codes, and sequences. The control codes are the same as those for Diablo, so most software will be compatible. No program examples are provided. Excellent technical descriptions of the parallel port, timing, and the RS-232C requirements make interfacing the printer to a computer easy for a hacker. Technicians will appreciate the details. For example, the manual lists a three-line BASIC program to direct the printer to type like a typewriter (IBM BASIC).

SUMMARY

The Brother HR-1 is an excellent medium-duty letter-quality daisy wheel printer. The linear motor drive should give many years of trouble-free service. The versatility of being able to attach an optional keyboard makes this printer just right for some applications. The print quality is excellent; however, the 23 cps print speed is rather slow. Commercial users may wish to purchase a memory buffer to make printing operations more efficient.

BROTHER HR-15 LETTER-QUALITY PRINTER

Brother International Corp.
$599

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Good; Hacker - Excellent
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Small Commercial - Good; Home - Excellent

FEATURES
Daisy wheel letter-quality print head
13 characters per second (cps)
Bidirectional
10, 12, and 15 characters per inch (cpi); Proportional spacing
Two-color and bold print
110 characters per line at 10 cpi
Paper Width: 13.5 in.
Original plus 3 carbon copies
Centronics parallel interface, standard (RS-232C serial, optional)
Memory Buffer: 3K (additional 2K, optional)
Noise Level: 65 dBA
Weight: 19.6 lbs.
Keyboard: Optional

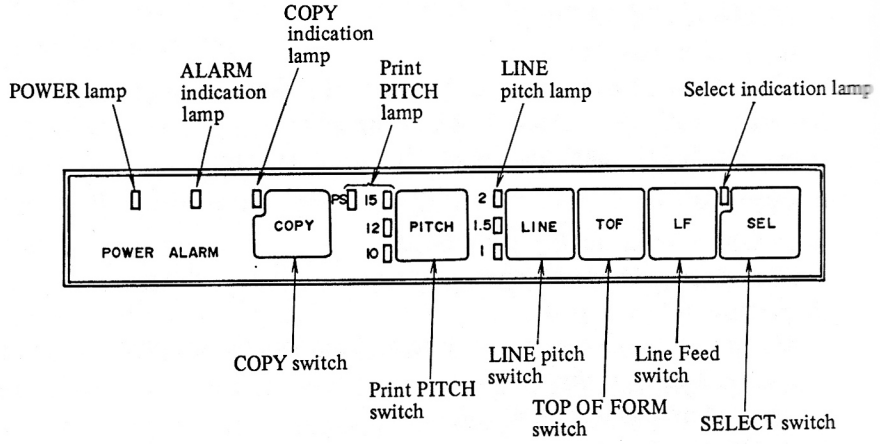
The home or light-commercial user who requires letter-quality print may want to give the Brother HR-15 consideration. With a print speed of only 13 cps, this is a very slow printer. If it is only needed occasionally or if there is no rush to complete printing, it is a very economical buy.

The HR-15 produces many special printing effects: two-color, bold, auto double-strike, auto underline, superscript, subscript, proportional spacing, and graphics printing. In addition, an optional plug-in keyboard turns this printer into a typewriter with an automatic correcting key. The memory buffer offers the ability to reprint text. That is, if the user wants duplicate copies of a document, pressing the COPY button will print two copies, provided the document can be stored in the buffer (3K buffer = 3000 characters; 5K buffer = 5000 characters).

The bidirectional print head movement enhances printing efficiency. An impression control allows the printer to vary the impact hammer's striking pressure, depending on the number of carbon

Operation

Switch Panel



Brother HR-15 Front Control Panel. Courtesy of Dynax, Inc.

copies being produced. Differential striking produces even-quality print by using less force for the smaller surface area characters (period, comma, i) and more force for larger surface area characters (m, w, s). This feature also prevents the daisy wheel from puncturing the paper.

Print wheels are available in twelve print styles for fifteen different languages (143 configurations). Print wheels cost $25 (foreign, $40.50), which seems a bit high when compared to a Diablo wheel, which costs from $10 to 12. The HR-15 print wheel is encased in a protective holder which reduces the chance of contamination. The manual lists the print wheels available and their part numbers. The cassette ribbon cartridge has a see-through window that helps the user determine how much ribbon is left on the spool.

The print quality is very good. In the 15 cpi mode the letters touch each other and are a bit difficult to read. The HR-15 vertical spacing produces single-, one-and-one-half, and double-spaced text.

Attractive Options

Other options available include a tractor feed and auto cut-sheet feeder. The tractor feed fits 12-in.-wide paper and costs $120. The cut-sheet feeder works with a maximum paper width of 8.5 in. and has a capacity of 150 sheets. The sheet feeder costs $250.

Plug-In Keyboard

The $195 touch-quality keyboard is an attractive option. Often, using a word processor to fill out forms and do simple tasks such as addressing envelopes is cumbersome. The typewriter-mode option may be highly desirable for some users. Plugging the keyboard into the printer shuts off the input from the computer.

Easy Operation

Membrane switches on the front panel allow the user to copy text in the buffer, change the character pitch, adjust the vertical spacing, move the platen to the top of the form, and to line feed. Indicator lights show whether power is on, the audible alarm is activated, and the copy function is on. Lamps also indicate which print pitch and line pitch is selected. The audible alarm signals the end of the ribbon, when the paper is out (tractor feed only), and when the cut-sheet feeder is empty.

Good Documentation Is a Plus

The 46-page manual plus an 11-page update tell the whole story—clearly written, they discuss each operation. The table of contents directs the user to the proper section; the manual lacks an index, however.

It gives good detail on specifications, control codes, and sequences. The control codes are the same as Diablo's, so most software will be compatible. No program examples are provided. Excellent technical descriptions of the parallel port, timing, and the RS-232C requirements make interfacing the printer to a computer easy for a hacker. Technicians will appreciate the details. For example, the manual lists a three-line BASIC program to direct the printer to type like a typewriter (IBM BASIC).

SUMMARY

The Brother HR-15 is an excellent light-duty letter-quality daisy wheel printer. The versatility of being able to attach an optional keyboard makes this printer just right for some applications. The print quality is excellent; but the print speed is quite slow.

BYTEWRITER LETTER-QUALITY-PRINTER INTERFACE

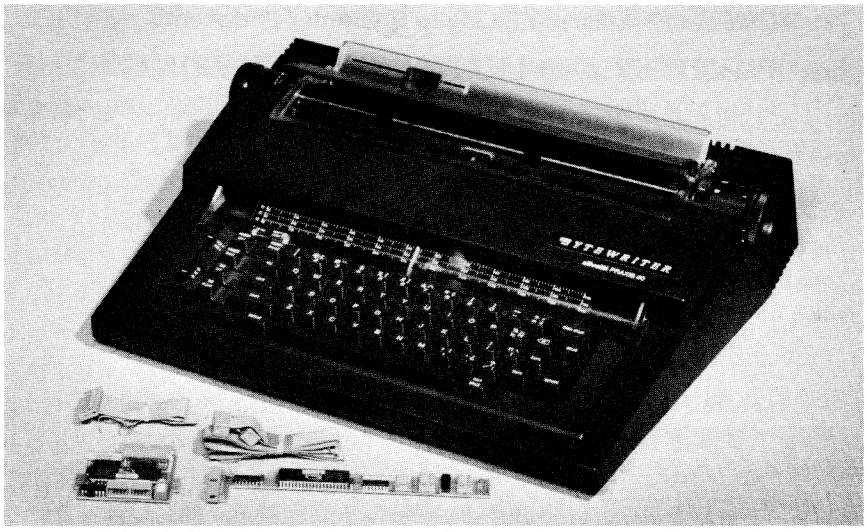
Bytewriter
Model 0-35 (Olivetti Praxis 35): $495; Model 0-40 (Olivetti Praxis 40): $595

PERFORMANCE RATING
Performance: Good
Documentation: Fair
Ease of Use: Good
Usage: Home - Excellent; Light Commercial - Good

FEATURES
Daisy wheel letter-quality print head
Keyboard: Standard, built in QWERTY
8 to 12 characters per second (cps)
Pitch: 10, 12, or 15 characters per inch (cpi) with underlining
Paper Feed: Friction (typewriter mechanism)/single-sheet feed (no continuous-form feed)
Paper Size: Up to 11 in. print line/13 in. paper width
Indicators: On line; uppercase activated; audible end-of-line signal
Interface: Parallel
Internal Memory: Last 10 characters typed manually can be corrected automatically by stroking the CANCEL key
Ribbon: Cloth, carbon, and correction cartridges
Dimensions: Model 35 - width 16.5 in. × height 4.3 in. × depth 13.7 in.
Model 40 - width 18.7 in. × height 5.3 in. × depth 15 in.
Weight: Model 35 - 21 lbs.; Model 40 - 19.4 lbs.
Portable carrying case included

Bytewriter manufactures a printer interface for Olivetti Praxis 35 and 40 electronic portable typewriters. The combination is a very versatile machine. The Praxis 40 is slightly more rugged and is quieter than the Praxis 35. As a printer, it's a perfect companion to a portable computer. A traveler can use the typewriter independently of the computer and still have matching type. The print speed is slow. It took me about two to two-and-one-half minutes to print a double-spaced page.

Although the printing speed is quite slow, the print quality is excellent. The unit offers single, one-and-one-half, and double spacing. The only real disadvantage to this printer is that it will not continuous-form feed. The user must manually advance the paper from



Bytewriter with Praxis 40 Printer. Courtesy of Bytewriter

page to page or single-sheet feed the paper. For short documents this is no problem; for long documents, however, this may slow printing operations even further. When the printer is turned off, it forgets its margin settings. New margins must be set each time the printer is used.

As a typewriter, the system is very nice. You can overtype or type faster than the printing speed, and the daisy wheel will "catch up." If you make a mistake, simply back up to the error. If it's within ten characters of where you stopped typing, strike the CANCEL key and the Bytewriter remembers what the erroneous character is. A built-in correction ribbon "erases" the error and you can manually enter the correction.

Maintenance is not a problem. Any Olivetti service center can repair the typewriter mechanism. The printer interface board may be slipped out and sent to Bytewriter for replacement or repair. The documentation is a scant eight pages. The only technical information is a pin-out assignment for the parallel connector.

SUMMARY

The system is a unique letter-quality printer that also serves as a portable typewriter. Since the base unit is an Olivetti typewriter, service is generally available. The speed is slow and the print quality excellent. The only drawback is its inability to form feed; that is, to advance forward to another page on computer command.

DAISYWRITER 2000 LETTER-QUALITY PRINTER

Computers International, Inc.
$1495

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Good; Hacker - Excellent
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Small Commercial - Good; Home - Excellent

FEATURES
Daisy wheel letter-quality print head
20 characters per second (cps)
Unidirectional
10, 12, 15 and 19 characters per inch (cpi); Proportional spacing
Two-color, bold print, expanded spacing
Paper Width: 13.5 in.
Original plus 3 carbon copies
Centronics parallel interface and RS-232C serial interface, standard
Memory Buffer: 16K (additional 32K, optional)
Four Z80 microprocessors
Noise Level: Low
Graphics Capabilities: 120 dots per inch (dpi) horizontal; 48 dpi vertical
Keyboard: Optional

The home or small-commercial user who requires letter-quality printing will find that the DAISYWRITER 2000 prints very nice looking documents. With a print speed of 20 cps, this is a slow printer. The manufacturer claims performance of 35 cps; however, the best we could measure was about 30 cps when printing columnar tables. If there's no rush to complete printing, this printer is a good performing unit.

The DAISYWRITER 2000 is essentially the same printer as the Brother HR-1, with two major enhancements—the addition of intelligence and more memory. The intelligence and control offered by the four Z80 microcomputer chips make this a very flexible printer. The DAISYWRITER 2000 can do both vector and dot graphics and can address dots on an absolute or relative movement. The printer scrolls the paper up or down.

The 16K buffer with an optional 32K expansion (total of 48K) built-in memory capability relieves the computer from monitoring printer performance, provided the job can be stored in this memory

size—saving the additional expense of $200 to $400 for a memory buffer unit. The memory buffer also offers the user the ability to reprint text. That is, if the user wants duplicate copies of a document, pressing the COPY button prints two copies, provided the document can be stored in the buffer (16k buffer = 16,000 characters; 48K buffer = 48,000 characters).

The linear drive motor will not wear out as fast as some other mechanisms. This makes the DAISYWRITER 2000 more suitable for light- to medium-duty commercial use, that is, not for continuous printing. The unidirectional print head movement is not as efficient as a bidirectional one. However, the planning and execution capabilities of the Z80 processors increase the effective output.

This printer is capable of producing many special printing effects: two-color, bold, auto double-strike, auto underline, superscript, subscript, proportional spacing, expanded spacing, and graphics printing. The printer produces a wide variety of expanded and compressed printing as well as a large variety of vertical line spacing. The print quality is very good. However, in the 15 cpi mode, the letters touch each other and are a bit difficult to read.

An impression control allows the printer to vary the pressure with which the impact hammer strikes (depending on the number of carbon copies being produced). Differential striking produces even-quality print by using less force for the smaller surface area characters (period, comma, i) and more force for larger surface area characters (m, w, s). This feature also prevents the daisy wheel from puncturing the paper.

Print wheels are available in twelve print styles for fifteen languages (143 configurations). Print wheels cost $15, comparable to the Diablo wheel which costs $10 to $12. The manual also lists the print wheels available along with their part numbers.

The cassette ribbon cartridge see-through window helps the user determine how much ribbon is left on the spool.

Other options are a tractor feed and auto cut-sheet feeder. The tractor feed fits 12-inch-wide paper and costs $120. The cut-sheet feeder works with a maximum paper width of 8.5 inches and has a capacity of 150 sheets. The sheet feeder costs $250.

Easy Operation

Membrane switches on the front panel allow the user to copy text in the buffer, change the character pitch, adjust the vertical spacing,

move the platen to the top of the form, and to line feed. Indicator lights show the user if the power is on, the audible alarm is activated, and the copy function is on. Switch positions indicate which print pitch and line pitch is selected. The audible alarm signals the end of the ribbon, when the paper is out (tractor feed only), and when the cut-sheet feeder is empty.

Good Documentation Is a Plus

The 46-page manual, 2 and 1/2-page table of contents, and 8-page index give the user quick access to information. The manual is not fancy, but is clearly written and discusses each operation. The command summary section makes the printer easy to use—I could always find what I was looking for.

The number of options available may confuse the novice. However, the dealer can set up the printer to work with the user's hardware and software prior to delivery. The manual will tell the dealer exactly how to configure the printer for each job required. Twenty-four DIP switches allow selection of continuous or sheet feed, 6 or 8 lines per inch, sixteen languages, baud rate, printer interface, auto line feed, and eight protocols which emulate commands used by other popular printers. The manual gives good detail on specifications, control codes, and sequences. No program examples are provided. Excellent technical descriptions of the parallel port, timing, and the RS-232C requirements make interfacing the printer to a computer easy for a hacker. Technicians will appreciate the details.

SUMMARY

The DAISYWRITER 2000 is an excellent medium-duty letter-quality daisy wheel printer. The linear motor drive should give many years of trouble-free service. The four Z80 processors make this a very intelligent and versatile printer with numerous printing and interfacing options. The 16 to 48K buffer gives the printer enough memory capacity to relieve the computer from printer operation monitoring. The print quality is excellent; however, the 20 to 30 cps print speed is rather slow. Commercial users may wish to expand the memory buffer to make printing more efficient.

DIABLO MODEL 620 DAISY WHEEL PRINTER

Diablo Systems, Inc.
$1050

PERFORMANCE RATING
Performance: Excellent
Documentation: Good
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home - Excellent; Commercial - Good

FEATURES
Maximum 25 characters per second (cps); average 20 cps
98 character plastic daisy wheel
10 cpi (132 columns); 12 cpi (158 columns); 15 cpi (198 columns); Proportional spacing
Maximum Form Width - 15.2 in.
Maximum Print Line Width - 13.1 in.
Paper Feed: Bidirectional; friction; optional tractor
Interface: RS-232C serial
Communication Rate: 110, 300, 1200 baud (up to 120 cps)
Buffer: .5K (512 bytes or characters)
Copies: One- to five-part forms
Dimensions: height 9 in. × width 24.5 in. × depth 17.5 in.
Weight: Approximately 50 lbs.
Options: Unidirectional tractor and sheet feeder
Noise Level: Less than or equal to 66 dBA

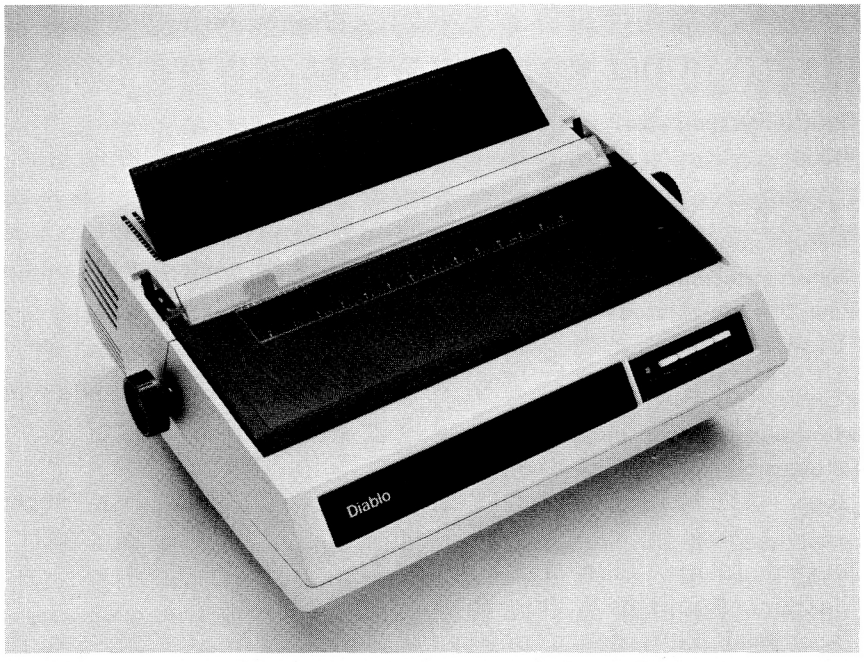
The Diablo Model 620 printer is an excellent letter-quality daisy wheel printer. It is versatile, and is even capable of plotting and graphics. The only drawback is its relatively slow speed. With its small buffer (512 characters) this printer will tie up a computer's time unless an external buffer is attached. This is true of almost all letter-quality printers.

Excellent Print Quality

The print quality is the best I've seen. It even produced up to four clear carbon copies using a 20-lb. original, four 15-lb. sheets of paper, and four pieces of carbon paper. Admittedly, the fifth page was fuzzy, but since I used heavy paper plus carbon, this printer should do fine on more typical multiple-copy forms.

Easy Operation

The printer is very easy to use. Directions for setting up the printer and installing the ribbon cartridge and print wheel are



Diablo Model 620 Letter-Quality Printer. Courtesy of Diablo Systems, Inc.

packed at the top of the shipping box. The print wheel has a unique locating capability that relieves the operator of having to orient it on shaft notches. Some 60 to 70 print wheels are available for different styles and languages. The cartridge ribbon has a see-through window that lets the user know when the ribbon is nearly out. The single-strike film ribbon is rated at 110,000 characters and the multistrike film ribbon at 440,000 characters.

Operating switches on the front consist of reset, pause, line feed, form feed, and power on/off. A status lamp indicates whether the printer is on/off line. The front cover latch is easy to actuate for removal. DIP switches located under the front cover are clearly labeled: baud rate, page size, line feed, printer-ready status, parity, and so on.

Quality/Heavy-Duty Construction

The cabinet is made of heavy-duty plastic. A steel frame supports the case interior as well as the printer carriage head. Steel aircraft control cables move the carriage. The platen is turned with steel gears meshed with plastic gears—a configuration that reduces wear.

The printer sits on a 3/4-inch rubber frame, and the inside of the case is lined with 5/8-inch-thick foam. Together with the hinged,

clear-plastic cover that encloses the top, these sound dampening techniques are quite effective.

The Manual Is Quite Good

The manual gives clear instructions for operating and communicating with the printer. For example, the manual lists the ASCII commands for setting margins, the horizontal/vertical motion index, carriage movement to a particular column, backward printing, vertical tab, negative line feed, super/subscript, graphics mode, and so on. The user can also use software to select two hammer-striking strengths.

The manual even describes how to clean the platen, rollers, and print wheel—something most manuals omit.

Diablo provides a toll-free number for service information and a customer service education number (not toll free) for obtaining audio/visual maintenance programs.

Warranty Could Be Better

The warranty covers parts and labor for 90 days. However, the warranty only covers the machine for 180 days from the time of shipment to the distributor. Therefore, if the user buys an "older" unit, the warranty may not extend the full 90 days. Diablo has five authorized warranty centers located around the country. The user must pay freight to the warranty station.

SUMMARY

The Diablo 620 printer is a fully-formed character serial printer designed for the low-speed, low-to-moderate output user. The RS-232C serial compatibility enables it to work with most personal computers. The friction platen and optional tractor feed let the user configure the printer to a number of applications. At 20 to 25 characters per second and with only a .5K buffer, this printer is relatively slow, as most letter-quality printers are. The print quality and construction are excellent. The Diablo 620 is an excellent printer.

JUKI MODEL 6100 LETTER-QUALITY PRINTER

JUKI Office Machine Corp.
$599

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Excellent; Hacker/Programmer - Excellent
Ease of Use: Good
Usage: Home - Excellent; Small Commercial - Good

FEATURES
18 characters per second (cps)
Daisy wheel (Triumph - Adler compatible)
100 columns at 10 characters per inch (cpi)
10, 12, 15 cpi pitch; Proportional spacing
13-in. platen (print line, 11 in.)
Ribbon: Cartridge (IBM Selectric II)
Centronics parallel, standard/RS-232C serial, optional
Dimensions: height 5.5 in. × width 19.75 in. × depth 13.75 in.
Weight: 31 lbs.

The JUKI 6100 letter-quality printer is an excellent choice for the user who needs low volume, letter-quality print. At 18 cps, this printer is ideal for the small office or home.

The JUKI is easy to use. In fact, I didn't even read the manual until

JUKI 6100 Daisy Wheel Printer. Courtesy of JUKI Office Machine Corp.

I wrote this review. I just plugged the printer in and began printing. Many of the operations will be familiar to those who have used an electric typewriter. The ribbon cartridge is a standard IBM Selectric.

Quiet Operation

The JUKI 6100 isn't as noisy as many impact daisy wheel printers. The nonabrasive noise level permits talking on the telephone next to an operating printer. The manufacturer rates the JUKI at 62 decibels at one meter.

Flexible and Efficient Printing Modes

The bidirectional printing and short-line-logic seeking capabilities make printing efficient. However, I frequently observed the printer printing in a unidirectional mode. Some printers automatically use this technique to reduce heat build-up in the print head.

The pitch is hardware selectible with a switch conveniently placed and labeled on the front of the printer. The switch selects 10, 12, or 15 cpi and proportional spacing. The proportional printing is very attractive and compacts the text to about 12 cpi. Proportional spacing leaves the equivalent of two to three characters of space between words, which seems a bit excessive; still, this spacing makes the text very readable.

Excellent Print Quality

The quality of print created by the carbon ribbon is sharp and very attractive; but the single-strike carbon ribbon provided with the JUKI didn't last very long. A multiple-strike carbon or cloth ribbon might be preferable. The printer makes a remarkably legible carbon copy. Two pieces of paper and a carbon feed easily through the platen.

Expandable Memory

The internal 2K buffer (memory) will store approximately 2000 characters or 400 words. The buffer allows the computer to send the text to the printer, so the computer can proceed with other tasks. With only 2K, the user can send only a short letter. Any lengthier document would tie up the computer during much of the printing.

JUKI provides sockets for 6K of additional memory. The user can simply plug in the memory chips and get a total memory buffer of 8K (8000 characters or 1600 words). If the user notices an error and wishes to stop printing, the printer must be turned off to clear the buffer memory. This requires reaching behind the printer, locating the on/off switch, and pressing it.

The JUKI occupies approximately 20 square inches, weighs 31 lbs., and cannot be readily moved from one place to another, as can some small dot-matrix printers. Its weight and size indicate that JUKI utilizes quality construction and heavy-gauge metals and plastics. The mechanisms appear sturdy and durable.

We did not test the optional tractor and cut-sheet feeder. Since the paper tends to crawl sideways with the friction feed, we recommend a tractor for printing mailing labels and forms.

Excellent Documentation

The manual is thick and easy for the novice to read. When I installed WordStar, I found that the procedures worked and were easy to follow. It is much better than the Epson manual. Although I looked for quite a while, I could not find which IBM ribbon to buy. I finally had to take the ribbon to a dealer who identified it as a Selectric II. This information should be added to the manual or, if it is there, should be more visible.

When an associate of mine plugged the JUKI into his compatible Centronics parallel port, it didn't work because the strobe line signal on the Epson and the JUKI are inverted. The JUKI requires "not-strobe" on this pin. The manual helped him troubleshoot this problem since the names on the pin designations are indicated. Even the hacker will like this manual.

SUMMARY

The JUKI Model 6100 is an excellent light-duty letter-quality daisy wheel printer. It is competitively priced at $599. The printer is easily interfaced with computer equipment, and requires a minimum of user orientation. The switch on the front makes it easy to select font size and proportional spacing. The noise level is quite acceptable for offices where telephones are in use. Due to the slow printing speed (18 cps), the user may wish to upgrade the memory buffer from 2K to 8K by easily plugging in extra memory chips.

NEC 3550 LETTER-QUALITY PRINTER

NEC Home Electronics (U.S.A.), Inc.
$2250

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Commercial/Small Business - Excellent

FEATURES
Letter-quality print
Thimble print head
33 characters per second (cps)
Bidirectional printing
Print Line: 136 columns at 10 characters per inch (cpi)
Pitch: 10, 12, and 15 cpi; Proportional spacing
Maximum Paper Width: 16 in.
Resolution: Horizontal - 120 increments per inch; Vertical - 48 increments per inch
Multiple Copies: Original and five carbon copies
Noise Level: 60 dBA with cover
Interface: RS-232C serial and Centronics parallel ports
Baud Rate: 75 to 9600 bps
Weight: 37.4 lbs.

The NEC 3550 letter-quality printer is an excellent printer for the moderate-to-heavy user who needs fully-formed-character quality printing. The print quality is even, dark, and easy to read. The ability to produce an original and up to five carbon copies makes the printer suitable for multiple-copy reports and correspondence applications.

The printer has many built-in word processing functions that allow it to interface with popular word processing software. It also produces limited graphics. The horizontal resolution is 120 increments per inch and the vertical resolution 48 increments per inch. The paper moves forward or in reverse—up or down.

The NEC 3550 is a very versatile machine, and one of the best printers I've seen. The front panel has a reset button, form-feed button, on/off line button, top-of-form button, and four DIP switches to manually set parameters. The user can also activate a test mode to check printer performance.

Special character sets are available by buying 128 different character thimbles; for example, Arabic, Greek, or technical.

The printer produces 10, 12, and 15 characters per inch. In the 10 cpi mode the printer prints 136 columns; in 12 cpi, 163 columns; and in 15 cpi, 203 columns. Proportional spacing varies the width of the spaces between letters. This permits an "i" to occupy less space than a "w". The NEC produces 6 or 8 lines per inch vertically in forward or in reverse. Red, black, and blue ribbons are available.

For an impact printer, the NEC 3550 is very quiet. The manufacturer rates it at 60 dB. The user can easily carry on a telephone conversation within a few feet of the operating printer.

Versatile/Easy Operation

Paper is fed from the front or from the bottom. The front single-sheet feed is useful for feeding glued forms and ledger cards. Most printers cannot handle this application well. The front inserter automatically feeds 4.3-inch- to 14-inch-wide paper. The paper may be ejected from the top or bottom of the printer.

Pin, tractor, and sheet feeders are available as optional accessories. The tractor adjusts from 3 inches to 15 inches in width and will handle one- to six-part forms. An envelope feeder alternately feeds envelopes with the single-sheet feeder. This way a mail merge program can alternately prepare a letter on letterhead and then print an envelope. The cut-sheet feeder handles 5-inch- to 16-inch-width paper from 3.5 to 16.5 inches in length. The dual bin adapter handles up to 180 sheets of 18 lb. paper stock; it can handle as much as 13 to 24 lbs. of paper.

The Demon Document Tractor prints and separates one- to five-part forms. The out-of-paper detector stops the printer until the user can load more.

The printer has no internal buffer, so the user may wish to invest in a memory buffer to relieve the computer from monitoring printer operations. The manufacturer rates the throughput at 350 words per minute or approximately one single-spaced page per minute.

Heavy-Duty Construction

The NEC 3550 is housed in a heavy-duty metal frame. Dealers report that they do not receive these units for repair. Owners only have to buy thimbles and ribbons. The unit comes with a 90-day warranty and NEC provides a customer support number, but it is not toll-free.

The printer operates with either a serial RS-232C or Centronics parallel interface. Most personal business computers should be able to communicate with this printer without adapters.

Good Documentation

The manual gives excellent details for the knowledgeable user and dealer. It's written in adult-level, clear English. A quick reference chart provides conversion of ASCII, hex, and decimal equivalents. Program control codes and sample programs show how the codes may be used with the printer. The manual also explains pin outs, interfacing, signals, and timing. Serial input may be varied between 75 and 9600 baud. The specification sheet in the manual is nicely done.

SUMMARY

The NEC 3550 is an excellent letter-quality printer for commercial use. However, the 33 cps speed limits the volume that it can produce. Many businesses would want to add a memory buffer to relieve the computer from monitoring the printing process. The numerous accessories increase the printer's versatility and ease of use. The documentation is excellent and easy to read. Dealers report that this printer is virtually maintenance-free. This is one of the finest letter-quality printers available.

SPINWRITER MODEL 2050 LETTER-QUALITY PRINTER

NEC Home Electronics (U.S.A.), Inc.
$1095

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Good
Usage: Commercial - Excellent

FEATURES
Speed: Up to 20 characters per second (cps)
Bidirectional, short-line-logic seeking
Character Sets: Many thimbles available
Pitch: 10, 12, and 15 characters per inch (cpi)
Print Line: 136 columns at 10 cpi; 163 columns at 12 cpi; 203 columns at 15 cpi
Italics, underline, double strike, superscript/subscript
Standard, compressed, expanded, proportional spacing
Paper Width: Up to 16 in.
Paper Movement: Forward or reverse, up or down
Multiple Copies: Original plus 4 carbon copies
Ribbon: Cartridge - black, brown, blue, red
Interface: Centronics parallel
Buffer: None
Dimensions: length 14 in. × width 21 in. × height 6 in.
Weight: 26 lbs.

The NEC Spinwriter is an excellent commercial letter-quality thimble printer. It does not use a daisy wheel or ball print head. Instead, the head is shaped similarly to an enlarged sewing thimble with raised characters that strike the ribbon against the paper to create the character. The print quality is superb.

The Spinwriter is compatible with most standard word-processing package commands. It can underline, double-strike, change pitch, and print superscripts/subscripts under software control.

The manual I examined, written for the IBM PC, is very clearly written. The set-up instructions are clear but complex enough so that the printer should be set up by the dealer. The DIP switches at the rear of the unit allow the dealer to configure the unit to many possibilities. The manual's line drawings and directions show how to install the thimbles, ribbons, and print masks. The troubleshoot-

ing guide and glossary of terms are very helpful. Programming samples illustrate how ASCII codes control the printer.

The printer is very easy to use and operates quietly. Its rugged construction suggests that the printer should last a long time. NEC warranties the unit for 90 days; an additional warranty period may be purchased. The dealer reported that the printer needs very little service.

SUMMARY

The NEC Spinwriter Model 2050 is an excellent letter-quality printer that can perform most word processing and office functions. Its heavy-duty construction suggests that the printer should stand up to commercial use. The documentation is excellent; however, set-up instructions are at a level of complexity that a dealer should configure the unit for the user's application.

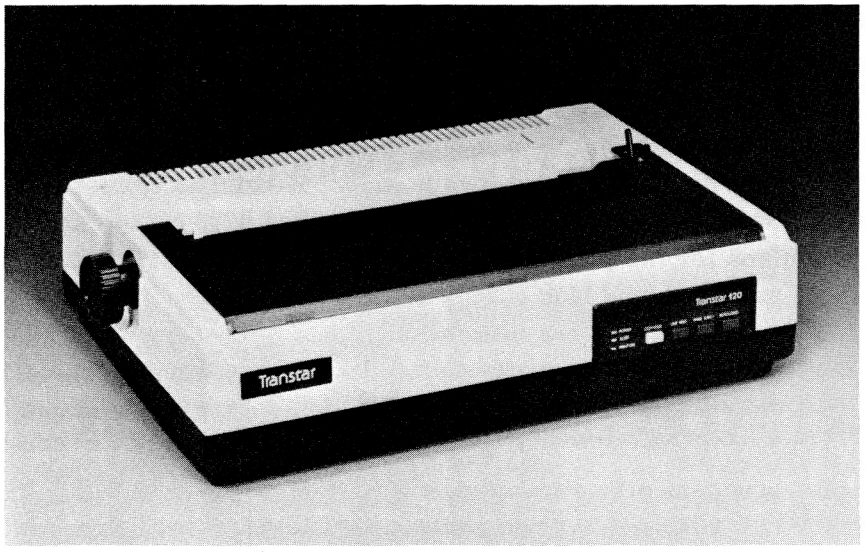
TRANSTAR 120 AND 130 DAISY WHEEL PRINTERS

Vivitar Computer Products, Inc.
Model 120: $550; Model 130: $699

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Good
Usage: Home - Excellent; Light Commercial - Excellent

FEATURES
Print Speed: Model 120 - 14 characters per second (cps); Model 130 - 18 cps
Fully-formed daisy wheel characters
Underline, superscript, subscript
10, 12, and 15 characters per inch (cpi)
Form Width: Model 120 - 12 in. maximum; Model 130 - 17 in. maximum
Column Width: Model 120 - 101 characters at 10 cpi; 121 characters at 12 cpi; 151 characters at 15 cpi
Paper Feed: Friction; optional bidirectional tractor
Auto paper load
Copies: Original plus three carbons
Ribbon: Cartridge (Olivetti-compatible)
Compatibility: Diablo 1610/1620 code compatible
Interface: Centronics parallel; RS-232C serial
Baud Rates: 300, 600, 1200, 2400, 4800, 9600
Buffer: 1790 characters (serial only)
Indicators: Power on/off, alert, print on
Controls: Auto load, line feed, page eject, pause/continue
Dimensions: Model 120 - width 17.5 in. × height 4.75 in. × depth 12 in.
Weight: Model 120 - 19 lbs.
Options: Carrying case - $49.95 (Model 120 only); Cut-sheet feeder (Model 130 only); Bidirectional tractor: $149.

The Transtar 120 and 130 are very compact, portable daisy wheel printers. The Model 120 I examined passed every test including autoloading, printing of individual shipping labels, three carbon copies, and envelopes. Although the 12 in. carriage capacity may limit the Model 120's use for financial report printing, it would be a very good printer for home or light commercial use. In the 15 cpi mode, the Model 120 can print 151 characters per line, which should accommodate most requirements. However, some people may have difficulty reading print as dense as this.



Transtar 120 Portable Letter-Quality Printer. Courtesy of Vivitar Computer Products, Inc.

The print quality is excellent even on the third carbon copy. Occasionally, the paper bail interfered with feeding items such as index cards and envelopes. The edge of the envelope wouldn't feed past the bail unless I raised the bail. After printing about three lines, the alert turned the printer off until I lowered the bail. Once I got the hang of it, I had no problem.

The documentation is quite good, except that a novice may feel confused by the DIP switch settings. The manual doesn't explain what the switch options mean.

The auto load and eject buttons work well. The carbon copy sheets didn't slip apart during auto load. The pause/continue button is nice too. Having the platen knob positioned only on the left is a bit awkward, but nothing you couldn't get used to. The cover opens from the platen toward the front for easy access to the paper and ribbon cartridge. The printer seems to generate a fair amount of heat even when not printing, so care should be taken not to block the ventilation holes on the back.

The Vivitar is attractively housed in a portable-styled case. Color-coded buttons (not membrane switches) set off the package even more.

SUMMARY

The Vivitar Transtar 120 and 130 daisy wheel printers perform all necessary letter-quality printing for home and most light-duty office

applications. Since the Model 120 carriage only handles 12-inch paper, it may not print some wide-width financial reports unless the 15 cpi pitch is used. The 17-inch-wide Model 130 might be better for office applications. At 14 cps for the Model 120 and 18 cps for the Model 130, the printers are pretty slow; but they have many attractive options for the price. Anyone needing an inexpensive letter-quality printer should look closely at the Transtar line.

Plotters

SWEET-P PERSONAL COLOR PLOTTER

Enter Computer, Inc.
$795

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Good; Hacker - Excellent
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home - Excellent; Light Commercial - Good

FEATURES
Drawing Media: Paper, film
Size: 8.5 in. × 11 in. or 8.5 in. × 118 in. (11 sheets)
Plotter Area: 1838 × 2500 units
Speed: 6 in. per second
Font Sizes (ROM): 4
Alphanumeric Character Size: 1/8 to 20 in.
Step Size (Resolution): .004 in. (250 steps/inch)
Manual Drawing Controls: 12 membrane switches
Interface: Centronics parallel (similar)
Dimensions: height 3 in. × depth 9 in. × width 14.5 in.
Weight: 6.5 lbs.
Software: Demo and tutorial included

The Sweet-P flat-bed plotter is small enough to fit in a briefcase. It comes with four colored felt tip pens which lock into a single holder, one at a time. The demo/tutorial disk guides the novice through standard operations. Drawing on film or transparencies requires special pens.

The tiny, precise pen movement can be activated manually or under program control. Twelve membrane switches on the front panel permit the user to move the pen manually in eight directions. These switches will also temporarily stop plotting and initiate the self-test mode. The printed text resembles letter-quality print. Small characters are rounded and quite readable; but on closer inspection, diagonal lines appear slightly staggered. For most business drawings the irregularity would not be noticeable. However, computer-aided design or drafting applications require better print quality.

Sweet-P contains four character font sizes in ROM (internal memory). In addition, the user can draw alphanumeric characters

from 1/8th of an inch up to 20 inches. The ability to make drawings up to 10 feet long is impressive for such a small unit.

Although the manual is a little technical for nonprogrammers, it's well done. The easily referenced documentation provides excellent illustrations, a troubleshooting chart, and list of things not to do.

Installation of the plotter is aided by a special "Y" switch which allows both the plotter and a printer to be hooked to the parallel port. A memory buffer lets the plotter print several pages independently of computer supervision.

An optional accessory kit with pens, transparency sheets, and other materials costs $100.

Sweet-P warranties the plotter for 90 days.

SUMMARY

The Sweet-P plotter is easy to use and produces quite acceptable charts, graphs, and drawings. Considering its low price, the plotter's capabilities and flexibility are impressive. Producing a multiple-colored drawing requires changing pens and drawing one color at a time. Enter Computer provides pens for both paper and film (transparencies). The print quality is not up to computer-aided design standards, but it's very good for small-business applications.

HP 7470A COLOR PLOTTER

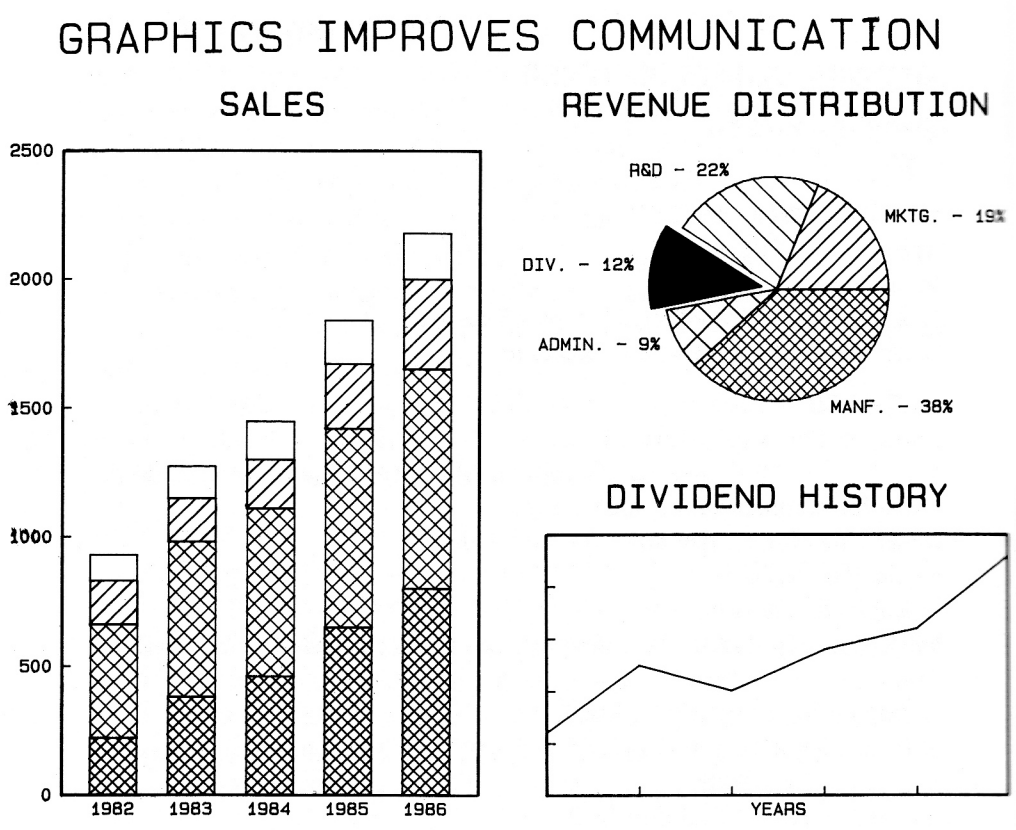
Hewlett-Packard Co.
$1095

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Novice - Fair; Hacker - Excellent
Usage: Home/Commercial - Excellent

FEATURES
Character Set: 5 fully-formed sets
Paper Width: 8.5 in. × 11 in. (European, 210mm × 297mm); Standard "A" size for commercial art and drawing
Colors: 10 colors; 2 pen sizes for each color
Resolution: .001 in.
Repeatability: .004 in.
Pen Speed: Up - 20 in./sec.; Down - 15 in./sec.; Internal vector generation
Scaling ability (magnify/reduce)
Interface: RS-232C [HP-IB (IEEE 488 - 1978); HP-IL, optional]
Baud Rate: 70 to 9600
Indicators: Error condition LED
Languages: HP-G (HP Graphics Language); BASIC
Dimensions: length 14.5 in. × width 21.4 in. × height 6.1 in.
Weight: 26.4 lbs.

The Hewlett-Packard HP 7470A color plotter produces excellent quality color graphics and letter-quality characters. The plotter achieves high speed by moving the pen in the Y-axis and the paper in the X-axis. This process creates complex plots without wasted time and motion. For extra neatness, the user can slow the speed from 38.1 cm/sec. to 3.8 cm/sec. by means of the velocity set instruction.

The microgrip drive (friction rubber rollers) for retaining the paper provides extremely good resolution. The pen-lift mechanism damper prevents pen tip damage. The RS-232C connector and DIP switches are conveniently located on the rear panel. The 60 dBA noise level is quite acceptable for home or office. A 255 character buffer allows the printer to "plan" an efficient plotting path. The plotter requires no adjustments, expensive stepper motors, paper sensors, or cooling fans.



Print Sample: HP 7470A Plotter. Courtesy of Hewlett-Packard

The manuals are the finest available. A fold-out reference card lists the most relevant and frequently used information. The 225-page Interfacing and Programming Manual has a very detailed table of contents and a 7-page subject index. Each chapter states clearly what you will learn and defines new terms, gives many examples and lists BASIC programs that illustrate command sequences and operations. The Operator's Manual shows many accessories and optional items available, including 20 different pen packages, paper options, and an overhead transparency kit.

An experienced user will find that the plotter is extremely easy to use. A built-in microprocessor allows features such as character generation, vector plotting, and internal, stored line styles. The plotter will automatically reconfigure or scale a graphic or character to fit a certain area. The plotter will condense, expand, enlarge, or reduce all images and characters. Since it uses the HP-GL language, used to communicate with all of H-P's scientific and engineering

plotters, the 7470A is compatible with any H-P test instrument equipped to produce graphic output.

The plotter manages up to two pens under software control. Each may be exchanged for other colors and pen widths.

As a digitizer, the H-P plotter can input two-dimensional data into the processor. The user traces the existing line drawing with the reticule (eyepiece). Movement is converted into digital information which the plotter can later reproduce. H-P does not support digitizing with software.

SUMMARY

The HP 7470A color plotter is very precise, fast, reliable, and relatively easy to interface and use. It will handle up to 10 colors with two pen widths each. Many built-in intelligent functions make programming the plotter relatively simple. The documentation for interfacing and operation is the best I've seen for any computer equipment. The HP 7470A plotter is economically priced and good enough for high-quality drafting applications.

VP-6801P PANASONIC DIGITAL PLOTTER

Panasonic Industrial Co.
$1595

FEATURES
Six color graphics at 16 in. (400mm) per second
Programmable Step Size: 0.1mm
Pen Response Speed: 5 times per sec.
Chart Paper: DIN A-4 (8.6 in. × 11.8 in.)
Colors: Black, red, purple, blue, green, brown
Automatic chart advance (optional)
Character Generator: 100 alphanumerics
Point Marks: 7 types
Paper Holding: Electrostatic
Plotting Area: Y-axis 7.2 in. / X-axis 10 in.
Pen Type: Fiber tip, plastic tip, or ball point
Inks: Water-based (all pens); oil-based for fiber pens
Interfaces: RS-232C serial; Centronics parallel; GP-1B (IEEE-488 compatible)
Dimensions: height 6.4 in. × width 14.4 in. × depth 16 in.
Weight: Approximately 20 lbs.
Options: Paper-feed unit, paper tray unit, I/O signal divider (Centronics)

Unfortunately, I couldn't get a VP-6801P plotter to examine personally. However, I feel that this book would be incomplete without at least mentioning some of the VP-6801P features. I extracted the information in this summary from sales literature provided by Panasonic.

The VP-6801P is an intelligent plotter that produces quality graphics. The ability to automatically draw circles, arcs, pie sections, grids, dot-dash lines, characters, and seven kinds of point marks is built into this plotter. This makes programming the plotter very simple. For example, D=Draw; M=Move, C=Circle, H=Home, P=Print, CTRL J=New Pen, and CTRL F=Feed Paper.

The drawing paper is held by a unique electrostatic paper-holding method. This guarantees secure paper holding and high plotting accuracy. The plotter supports graphing, geometric drafting, 3-D graphics, mapping, and interactive design. Typical applications include engineering drawing, industrial design, and housing design.

Chapter 2

Monitors, Terminals, and Keyboards

Many computers have built-in terminals. That is, the screen, keyboard, and central processing unit (CPU) are housed in a single cabinet; tape or disk drive units may also be in this cabinet. An example of this design is the Radio Shack TRS-80 series.

Some manufacturers package their units separately. For example, Atari puts the keyboard and CPU together and provides separate mass-storage units. Most Atari users connect their systems to color television sets instead of expensive monitors. OSI (Ohio Scientific) puts the CPU and disk drive into a single case and runs an RS-232C serial cable to a separate terminal (monitor and keyboard combined)—the Hazeltine 1500 terminal, for example. Manufacturers such as Kaypro and Compaq separate the keyboard from the computer so that the user may adjust the keyboard position independently. Stand-alone swivel- and tilt-based monitors such as Qume provide additional flexibility and comfort.

Shopping for a terminal, monitor, and keyboard may be an integral part of shopping for a computer system. The quality of the built-in display, the design of the keyboard, and the screen capabilities all play an important role in making a decision. You must also be certain that the terminal, monitor, or keyboard is compatible with both the software and hardware being used. Software manufacturers usually provide documentation for configuring popular brands of terminals to their hardware and software packages. Without this advice, making a terminal work could be frustrating

and even impossible. Selecting a stand-alone monitor is much easier than finding a terminal.

The dealer may be the best source for advice on these purchasing decisions. However, before selecting an integrated computer system or a separate terminal, monitor, or keyboard, you may wish to answer the following questions:

1. How much can I afford to pay? _____
2. What computer/software am I going to use it with? _____
3. How does my computer communicate with a terminal or monitor? _____
4. What physical size/weight should it be? _____
5. Should the computer system be portable? _____
6. What special characters do I need? _____
7. What print sizes do I want? _____
8. What graphics capabilities do I need? _____
9. What picture quality do I need? _____
10. What size screen do I need? _____
11. What color monochrome display do I want? _____
12. Do I need full color capabilities? _____
13. What column width (characters per line) do I need? _____
14. Do I need special video (underlining, uppercase/lowercase letters, blinking, reverse video, etc.)? _____
15. Is glare a problem? _____
16. Do I need screen positioning (tilt/swivel/height)? _____
17. Do I need independent keyboard positioning? _____
18. What keyboard functions do I need? _____
19. Do I need touch-typing quality? _____
20. Do I need a ten-key numeric pad to enter figures? _____
21. Do I need programmable keys? _____
22. Do I need to produce sound? _____
23. Do I want a built-in modem? _____
24. Will the monitor/keyboard be used occasionally/constantly? _____

25. Will the keyboard be in a clean/dirty environment? _____

26. What is the short-term/long-term maintenance? _____

27. What warranty do I want? _____

28. What type of service do I need? _____

This chapter will help you find the equipment that best meets your needs.

When evaluating the above features, you might rate each feature as essential (+++), desirable (++), and nice, but can do without (+). Making compromises in the final choice may then be easier.

How Much Can I Afford to Pay?

The more you want the terminal (combined monitor and keyboard) to do, the more the terminal will cost. In general, dumb terminals cost less and smart terminals cost more. Dumb terminals may only allow you to input data on a keyboard and display information on a screen. Smart terminals like Qume and Televideo display upper- and lowercase letters and may have capabilities for blinking, underlining, reverse video, and cursor addressing (the ability of the computer to "know" where the cursor is located on the screen relative to other data). Smart terminals cost from $700 to $1200—and more.

Inexpensive, stand-alone monochrome monitors create black and white, green, or amber phosphor displays. Monochrome monitors cost from $100 to $300. Color monitors and those with extremely high resolution tend to be the most expensive. Composite color monitors cost from $250 to $550, and RGB color monitors cost from $550 to $1000.

Some users save money by using television sets instead of monitors. While this is great for the hobbyist, a television set may not be adequate for the word processing user. Many television manufacturers, Mitsubishi and Panasonic, for instance, are modifying television set designs so that they will serve as both televisions and high-quality color computer monitors. More about picture qualities later.

From the black and white television at $70 to the RGB (red-green-blue) color monitor which costs upwards of $550, you have a wide choice in price.

What Computer/Software Am I Going to Use It With?

The nature of the hardware and software to be used with the terminal or monitor may dictate the type of equipment required. For example, the manufacturer may provide recommendations and documentation for interfacing their product to certain terminals. Without this support, getting the terminal to communicate with the computer and software may be very difficult.

An application that requires entering large amounts of numeric data would best be served with a keyboard equipped with a ten-key numeric pad. Some software may require special function keys found on more "intelligent" keyboards and terminals. The software may require the use of CONTROL (CTRL), ESCAPE (ESC), and other functions for easy operation; for example, the BENCHMARK information processing software uses "FUNCTION 1" to activate many of its operations. A terminal with a conveniently placed "FUNCTION 1" key would be more efficient to operate than a keyboard like the IBM PCjr's, which requires the operator to both strike the FUNCTION key and then the number "1" to achieve the same result.

The software may support both color picture and sound generation. For example, the spread-sheet program used on the SONY SMC-70 prints negative numbers in red. Such an advantage would be lost on a monochrome monitor.

The software graphic capabilities may also dictate the degree of resolution required from the monitor. Jagged-edge circles for pie charts would not be impressive in a marketing presentation. However, a preschooler using Micro Illustrator may not be so picky.

How Does My Computer Communicate with a Terminal or Monitor?

A computer communicates or transmits characters (bytes of information) to a terminal in two ways. A byte consists of eight bits of information. A bit is represented by a 1 or a 0. Thus eight 1s and 0s (a binary code readable by the computer) form a single character such as an "a" or "$". In serial transmission, the electrical signals that represent the 1s and 0s pass through a single wire in single file. In parallel transmission, all eight 1s and 0s are sent simultaneously through eight wires. Thus the entire byte is transferred at the same time—a faster method.

Some terminals require a serial (RS-232C) connection and others a parallel (Centronics/IEEE) standard interface. Although the type of connection is not necessarily an advantage or disadvantage to terminal operation, the interface must be compatible between processor and terminal.

What Physical Size/Weight Should It Be?

The footprint of the terminal, monitor, and keyboard should fit the space allocated for them; for example, a terminal such as the Qume may require a couple of square feet at typewriter height. If the keyboard is detachable, it may require even more space. A stand-alone monitor may need to sit on top of the computer. If it's too large or heavy the computer may not tolerate setting the monitor on top. The application dictates size, weight, and space requirements.

Should the Computer System Be Portable?

Portable computers such as the Kaypro and Compaq are very attractive to traveling salespeople, writers, and others. The monitor is usually mounted in the console and the keyboard is a detachable "lid" that connects to the computer with a coiled cable. This highly efficient configuration saves on both weight and space. Make sure that unlike the IBM PC portable there is provision for tipping the computer up at an angle for easy screen viewing. And, make sure that the screen is large enough—a detail Osborne overlooked.

To some people 26 lbs. is portable. To others, such a weight requires a backpack or wheels. Just because a unit fits conveniently under an airplane seat does not mean it is portable. Many portables will support additional stand-alone monitors that provide larger and/or color displays. Some monitors have built-in handles to make transporting them easier.

What Special Characters Do I Need?

If you're writing a book called *Learning Hebrew Can Be Fun,* you will need some special characters and terminal capabilities. Engineers and mathematicians also need special symbols. ROMs (read-only memory chips) are available for many terminals required to input special applications and foreign languages. ROM enables the terminal to generate these characters on the screen and to communicate the correct information to the processor.

What Print Sizes Do I Want?

The size of the screen dictates print size. If the screen is small, the column width (characters per line) must be shortened or the size of the individual symbols must be reduced. If the screen is only used occasionally, the importance of print size is diminished. However, heavy data and word processing users will need an easily readable 80-column display.

What Graphics Capabilities Do I Need?

The resolution of the screen will determine the clarity of the picture. The image on the screen is composed of a large number of dots (pixels) which are periodically renewed (refreshed) by the electronic circuits. The larger the number of dots the clearer the picture.

A good test for resolution is to see a circle displayed on the screen. If the edges are ragged, the resolution is poor. If the circle is nearly perfect, the resolution is high. Of course, focus and other performance variables affect resolution. See a demonstration and decide for yourself what will work with the application.

What Picture Quality Do I Need?

Other than resolution, discussed above, the picture quality may be affected by the refresh rate and the persistence of screen phosphors. The circuits in the screen should renew the picture frequently enough to prevent flickering and to provide a steady image. The phosphors should sustain their emission of light long enough to maintain the image but not long enough to create ghosts when the screen changes to present new information. See a demonstration of information scrolling on the screen to test this feature.

In general, color TVs and composite color monitors produce poorer quality pictures than monochrome and RGB color monitors. Monochrome monitors are capable of producing the highest resolution displays. The RGB (red-green-blue) color monitor uses three (red-green-blue) guns to produce a single-dot image. Thus, to produce a green dot, only one in three pixels is illuminated—one-third the information conveyed by a monochrome monitor. This is why even a fine RGB color monitor will not produce as sharp a picture as a monochrome monitor.

Some computers, for example the Atari 800, don't support monitors and must communicate with televisions. The IBM PCjr won't communicate with a television without the addition of an RF-modulator. However, PCjr does support monochrome, composite color, and RGB color monitors. Make sure you buy the display device that's compatible with your computer.

TVs produce poorer quality pictures than monitors (often referred to as CRTs). By the very nature of television circuits, TVs do not receive and reproduce as much information (individual pixel information) as do higher quality monitors. By reducing the column width to 30 to 40 characters and by increasing the size of each character, TV can produce legible text.

The application will determine the image quality required. As a rule, applications with frequent screen proofreading or referencing dictate the use of monochrome monitors.

What Size Screen Do I Need?

The characters must be legible and the graphic representations must be clear and discernible. Generally, a 9 in. to 11 in. screen is quite adequate for close work. (See the section below: What column width (characters per line) do I need?)

Some of the plasma (liquid crystal) displays only show a few characters at a time; MicroWriter and Infone, for example. This makes proofreading and scanning text tedious.

Some users project their output onto wide-screen television for groups of viewers at conferences and meetings.

What Color Monochrome Display Do I Want?

The most common colors on U.S. color displays are white on black and green on black. Europeans use amber letters on a black background, although amber is also starting to appear in the U.S. as well. Green and amber displays seem to be easier on the eyes, especially for heavy users. However, if the focus, contrast, and brightness are adjusted to a pleasant level, the screens will not overly fatigue the eyes. The National Institute for Occupational Safety and Health (NIOSH) recommends an illumination of 500 to 700 lux, and that heavy CRT users take a fifteen minute break every two hours. Regular eye examinations for heavy users may be warranted.

Do I Need Full Color Capabilities?

Color greatly enhances many computer games. Software that produces graphs, charts, and graphic representations may also require multicolored displays. If the primary computer function is data and word processing input, a color terminal may not be desirable. You may wish to purchase both monochrome and full color monitors. For example, I use an Amdek amber monitor for word processing and an Amdek Color II Plus for color graphics and games. Make sure that both monitors will plug into the computer simultaneously. Having to fool with loose wires may be troublesome and hazardous.

What Column Width (Characters Per Line) Do I Need?

The screen must be capable of producing the number of columns of characters required by the software. For example, accounting software and word processing applications are most easily implemented on 80-column screens. Television sets and composite color monitors are not capable of producing a legible 80-column screen. As a rule, they are used in the 40-column mode.

Do I Need Special Video?

Smarter terminals can produce underlining, upper- and lowercase characters, blinking characters, and reverse video (black characters on a gray background). At times an application is enhanced by these features. For example, you may wish to print prompts in a weaker background intensity and your input in a stronger foreground intensity to make it easy to separate prompts from data. A blinking command is easier to spot on a cluttered screen. The terminal should be capable of producing these effects if they are needed.

Text typed in uppercase letters is difficult to read. Word processing terminals should display both upper- and lowercase. If you're buying a stand-alone monitor, make sure the characters are also legible in reverse video.

Is Glare a Problem?

Bright windows and lamps reflect on a CRT screen. Glare hampers reading and tires eyes. Many terminals and monitors have nonglare

screens. If not, they can be equipped with plastic panels that not only reduce glare, but are tinted to emulate the green phosphor CRT. Interior decorating can also reduce glare problems. Orienting the terminal to avoid lighting or installing dark drapes will serve the same purpose as buying an antiglare lens.

Do I Need Screen Positioning?

The National Institute for Occupational Safety and Health (NIOSH) recommends that the viewing distance be 450 to 500 mm from the eyes (approximately 20 inches). The angle of tilt or slope should be 10 to 20 degrees, with the top of the screen further away from the operator than the bottom. The top edge of the screen should be no higher than eye level and the bottom edge no lower than 40 degrees from the eyes. The keyboard (at home row) should be 740 to 790 mm from the floor (approximately 30 in.). Swivel and tilt screens like Qume's and detachable keyboards like Key Tronic's offer more flexibility for "ergonomic" placement of equipment.

Do I Need Independent Keyboard Positioning?

Some users do not refer to the screen frequently or do not have the desktop space to accommodate a keyboard. Some like to lean back in an easy chair with their keyboards in their laps. Whatever the reason, a detachable keyboard may be desirable.

What Keyboard Functions Do I Need?

The software and hardware dictates the best keyboard configuration. Much has been written lately about the inefficiencies of the QWERTY (standard typewriter) keyboard. In fact, the keyboard was designed for inefficiency, so that fast typists would not strike two typewriter keys so rapidly that they would jam together. A keyboard design that is rising in popularity is the Human Applications Standard Computer Interface (HASCI). The keyboard divides the computer system into a series of menus that link you to the computer. The fundamental actions required of a computer are placed directly on the keyboard—for example, save to disk, load from disk, and send to printer. Other keys may allow you to ask for

help, display the file index, stop computer processing, copy a disk, manipulate files, and set type style.

The Dvorak keyboard configuration places the most commonly used alphanumeric characters in convenient locations. Users claim that the Key Tronic Dvorak keyboard doubles their typing speed. Programmable keyboards can be altered to meet specialized input needs.

Adding control keys such as ESCape and ConTRoL expands keyboard codes. For example, striking "A" enters the letter "A." However, striking "CTRL A" may cause the cursor to return to the top left-hand corner of the screen. More than twice as many messages can be sent to the processor with the use of these control keys. The keyboard must have the keys that match the software.

Membrane keyboards provide protection from dirty environments. (See the section below: Will the terminal be in a clean/dirty environment?)

Do I Need Touch-Typing Quality?

The first question you might ask is, "Will the operator be a touch typist?" If not, touch typing quality may not be required. Some keyboards have sculptured and textured keys that improve the "feel." A small dot-like bump may identify the "f" and "j" on home row. In this way you will know if your hands are properly located. Small lights (LEDs) may signal when lock keys are activated; for example, the Key Tronic keyboard has an LED on the CAPS LOCK key.

Since "feel" is highly individual, you should try out the keyboard before deciding on a purchase. Also, the placement of frequently used keys such as BACK SPACE, DELETE, CONTROL, ESCAPE, SHIFT, TAB, RETURN, and CAPS LOCK should be tested for convenience. Sometimes computer manufacturers put keys in strange, inconveniently located places.

Do I Need a Ten-Key Numeric Pad to Enter Figures?

Some applications are best performed with a ten-key numeric pad, for example, statistical data analysis and accounting. The ten-key may be built into the standard keyboard on the far right margin. Make sure the pad has conveniently placed arithmetic operators (+, −, *, /) and an enter key. The ten-key numeric pad may come as a

separate peripheral. Separate ten-key numeric pads like those of Apple may be easy to position on a desk, but may tend to crawl around the desktop when data is being entered. A product demonstration may be warranted.

Both efficiency and accuracy in entering numerical data are improved with a ten-key numeric pad. The application dictates whether this feature is needed.

Do I Need Programmable Keys?

State of the art keyboards should be programmable, allowing the user to define or specify a particular key function. For example, the word processing user may wish to define a keyboard operation to mean "delete text." The software package may affect the user's ability to create user-definable keys.

Do I Need to Produce Sound?

Many games are greatly enhanced with sound effects such as those of explosions, race-car engines, and monsters. Computer hardware and software may or may not be capable of producing sounds. Computers like the IBM PCjr and Atari 800 are equipped with a speaker or noise-maker of some sort. Others require that a separate monitor or television have a speaker. Some computers produce auditory signals to indicate processing status such as when the user is about to overflow a file, when processing has stopped, or when a function key is activated.

Do I Want a Built-In Modem?

A terminal with a built-in modem allows the user to dial telephone calls from the keyboard. The terminal can connect with another computer in order to transfer data. Some terminals are equipped for automatic dialing and answering. For example, a menu may offer choices of ten bulletin boards or database services. You indicate your choice, and the terminal automatically dials the telephone number and establishes communication. If the receiving terminal has an auto answer modem, it will automatically answer incoming telephone calls and begin communicating with the computer at the other end of the line.

Modems may be purchased separately from the terminal. However, if a portable personal computer is needed the streamlining offered by a built-in unit may be preferred.

Will the Monitor/Keyboard Be Used Occasionally/Constantly?

The amount of terminal use dictates the quality and features that are desirable. Commercial-quality equipment will withstand constant use with fewer repairs and less down time. Also, tinted/nonglare screens are a plus if you are a heavy user.

Will the Keyboard Be in a Clean/Dirty Environment?

Membrane keyboards resemble the electronic spelling games available for youngsters. The keyboard is covered with a flat plastic sheet. Ridges in the sheet may define the location of the symbol. However, since kinesthetic feedback is poor, you may not know if the "key" is activated. These keyboards are sometimes equipped with a click or other sound generating device that makes an audible tone when the action is recorded. Membrane keyboards are particularly useful in dirty environments, which may gum up or corrode mechanical typewriter-like keyboards and electrical contacts.

Early IBM PCjrs used a different technique for sealing the keyboard circuits. A formed rubber sheet fits between the keys and the electronic switches below. Depressing the key presses on the rubber sheet, which in turn presses on the switch sealed from accidental spills.

What Is the Short-Term/Long-Term Maintenance?

The amount of use will affect the frequency of repair. Keyboards and disk drives are the two most frequently repaired computer peripherals because of their mechanical (instead of electronic) nature. Dirty environments may be harder on the keyboard and terminal circuits. References from customers who use the terminal in a way similar to yours is the best check on maintenance requirements.

What Warranty Do I Want?

Many manufacturers do not provide for local maintenance. Shipping the terminal, monitor, or keyboard to a repair facility will take

from seven to ten days in the best of circumstances. Be sure to save the original packing box in case shipping is required.

Check on the hourly repair rates and on what the warranty does and does not cover. Sometimes a warranty only covers parts, not labor. Few if any will cover freight charges. Some warranties begin when the unit is shipped to the dealer, not when it is sold at retail. Find out whether this policy will affect the length of your warranty. Check to see if there is a difference between a commercial and a home-use warranty. Make sure you can live with its terms. Thirty to ninety days is not an uncommon warranty period; some equipment, however, is warrantied for one to two years. The CRT tube may be warrantied for a longer period than the rest of the unit.

What Type of Service Do I Need?

How fast do you need your terminal returned if it breaks? Will you need a loaner or a back-up unit? If local service is provided, find out if they stock parts and employ factory-trained technicians. Some computer vendors may refer their service to another repair business. Check their references and labor rates. Find out what the repair turn-around time is.

If you are a heavy user you may want to purchase a spare terminal, monitor, or keyboard for back up.

The Checklist Provides the Answers

Once the checklist is complete and rated for priorities, the type of monitor or terminal required for the application will be clear. Compare these ratings to the following Product Reviews to determine which makes and models you should examine in person.

Monochrome Monitors

AMDEK VIDEO-300A AMBER MONOCHROME MONITOR

Amdek Corp.
$179

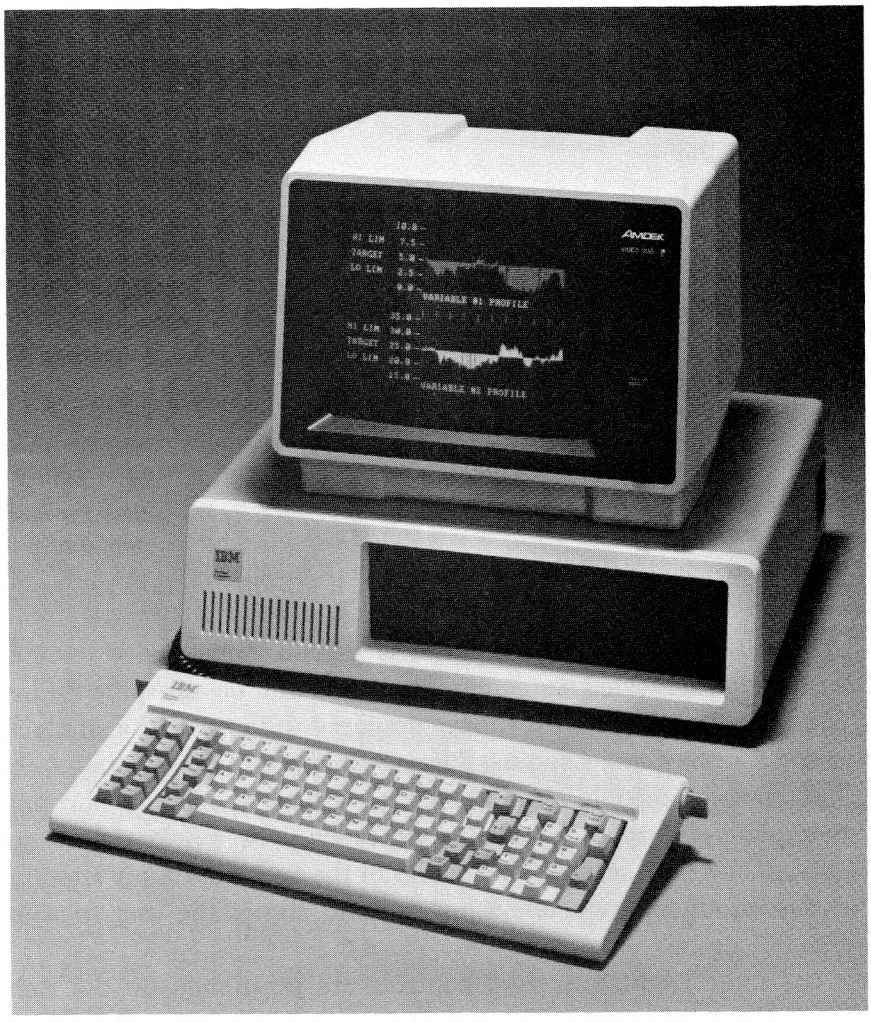
PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Good; Hacker - Good
Ease of Use: Excellent
Usage: Home - Excellent; Commercial - Excellent

FEATURES
Amber monochrome display
12 in. nonglare screen
Video Input: Composite video signal
Standard Video Input Interface: RCA phono plug
Dimensions: length 14 in. × width 14 in. × height 12 in.
Weight: 17 lbs.

The Amdek Video-300A monitor has the clearest display I've ever seen. The user can work with this monitor for many hours without eye strain. The dark shadow panel-frame and the nonglare screen enhance the image. On a scale of one to five, I rate the print quality number one. The crisp orange characters are still legible a few feet away from the screen. I could read the screen from across the room even though the characters are relatively small.

The brightness and contrast control-range allows the user to adjust the background to solid black. However, the maximum brightness level isn't very high (see also the Comrex CR-5600 review). The pull on/off, brightness, and contrast controls are located to the right of the screen. Additional controls are available on the back panel, and can only be accessed with a small insulated screwdriver—as they should be. The monitor was adjusted correctly at the factory.

The owner's manual is brief and clearly written. A troubleshooting guide helps the user determine the causes of typical problems. The hacker will appreciate the electronics schematic with part numbers. Any good technician can use this diagram to repair the monitor. The manual even provides oscilloscope wave forms for diagnostics.



Amdek Video-300A Monochrome Monitor. Courtesy of Amdek Corp.

The factory warranty is one year on parts and labor. The customer pays freight to return the unit to the factory.

We found that many dealers recommend this monitor for both its performance and durability. Hackers and technicians agree, saying that this monitor "never needs maintenance."

SUMMARY

The Amdek Video-300A amber monochrome monitor is an excellent buy for both home and commercial use. The clear amber display is easy on the eyes over many hours of use. The maintenance record is excellent.

BMC MODEL BM-12A GREEN MONOCHROME MONITOR

BMC USA, Inc.
$99

PERFORMANCE RATING
Performance: Fair
Documentation: Fair
Ease of Use: Good
Usage: Home - Good

FEATURES
12-in. green monochrome display
Composite video input
2000 characters
Dimensions: depth 11.5 in. × width 14.5 in. × height 11 in.

The BMC monochrome monitor is a good, inexpensive monitor for home use. I tested a green monochrome unit on an Apple II Plus. The characters were a bit fuzzy compared to those of the similarly priced Gorilla from Leading Edge. The horizontal portions of the characters seemed brighter than the vertical or slanted portions, giving the picture a speckled appearance. The monitor does not have an antiglare screen. The quality of the text is certainly superior to that produced by a television set, and allows the user to work with 80-column text.

The most frequently used controls are positioned on the right edge of the side panel. These include on/off, contrast, and brightness. On the back are recessed controls for vertical linearity, vertical height, vertical hold, and horizontal hold. A convenient cord-wrap bracket is molded into the case and a molded handle permits easy transportability.

SUMMARY

The BMC monochrome monitor is a relatively good device. The 40-column, 80-column, and reverse video displays are quite legible. The intensity of the display varies to create a speckled image. The characters are not as crisp or sharp as those of the Gorilla. The picture quality is certainly better than that of a television set, and would permit use of an 80-column display on a home computer. I don't recommend this monitor for commercial use; however, for home use it's acceptable.

COMREX MODEL CR-5600 AMBER MONITOR

Comrex International, Inc.
$189 (green, $179)

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Excellent
Usage: Home and Commercial - Good

FEATURES
Monochrome Display: Reddish orange (green/yellowish green, optional)
Antiglare screen
Screen Size: 12 in.
Video Signal: Composite
RCA phono jack
Characters: 80 columns × 25 rows (2000 characters)
Dimensions: length 14 in. × width 14 in. × height 11 in.
Weight: 15.5 lbs.

The amber Comrex Model CR-5600 monitor is compactly designed with a pull on/off control on the front panel. Concealed behind a small door on the right of the screen is the brightness and contrast control. A black shadow screen surrounds the antiglare CRT.

Display Could Be Sharper

I ran the IBM PCjr display diagnostics on both the Comrex and the Amdek Video-300A to compare picture quality. (See the review of the Amdek Video-300A.) I set the Comrex on high-level input instead of on low—the computer output determines which setting is needed.

In the 40-column mode the Amdek has a bolder raster and sharper image. In reverse video (40 columns × 25 lines) the black Amdek characters were easy to read. The Comrex characters were a bit fuzzy and the faded (low contrast) reverse video background made reading the black characters difficult. Adjusting the brightness control higher made the picture clearer. However, at this brightness level, the normal video mode (amber characters on a black background) was too bright.

In the 80-column mode the Comrex characters are bolder and a significant amount of brightness adjustment is available—much more than on the Amdek. In a very brightly lit office this could be an

asset. The reverse video on the Comrex was easier to read than on the Amdek since the Amdek background would not adjust to as bright a level as the Comrex.

The 160 × 200 patterned dot test revealed that the Amdek produces a much sharper image than the Comrex.

Installation Is Simple

The unit plugs into the computer with a simple RCA phono jack. Adjustment of the controls on the front panel is easy. An insulated tool provided by Comrex is needed to adjust the controls on the back: the vertical hold, horizontal hold, vertical size, and horizontal center. The unit also has a video-out port so another monitor can be hooked to the Comrex. The computer can thus drive two monitors, a handy feature for some applications.

The Manual Is Fair

The manual is nicely illustrated and has a good technician-level troubleshooting chart that illustrates problems and suggests technical explanations for them but fails to tell the user what to do. The manual's picture of the back of the monitor does not show that there are controls for horizontal centering and vertical size. The video out plug and high/low input switch are not labeled.

A circuit diagram tells the technician how to convert an RGB computer output to composite output.

Dealer Service

The unit has a 90-day warranty and the user is advised to contact the dealer for service. The operating guide doesn't provide an address or phone number for Comrex; but the limited warranty form does. Dealers report that the performance history for this monitor is good. I had a problem with the monitor received for review. Comrex sent another unit so we could evaluate the unit.

SUMMARY

The Comrex Model CR-5600 amber monitor is a good one; however, the images are not quite as clear and crisp as those on the Amdek Video-300A. Because of the wide range of brightness control, this monitor may be well adapted to a brightly lit office environment. The manual is adequate, but could have better troubleshooting information for the novice.

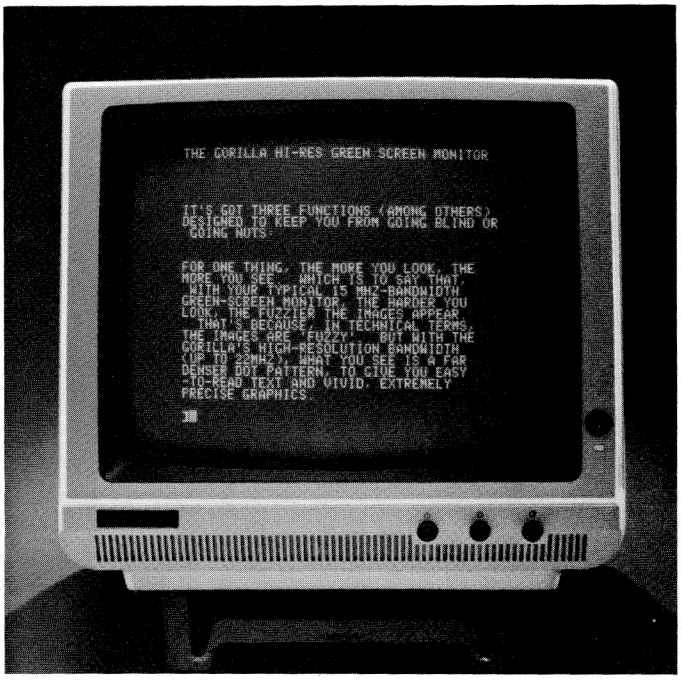
GORILLA MODEL 41-3-120 MONOCHROME MONITOR

Leading Edge Products, Inc.
$104

PERFORMANCE RATING
Performance: Excellent
Documentation: Fair
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home - Excellent; Commercial - Good

FEATURES
12-in. green monochrome display (amber available)
Antiglare screen
Composite video input
Resolution: minimum 800 lines at center
2000 characters
Dimensions: length 11.8 in. × width 13.6 in. × height 11.9 in.
Weight: 14 lbs.

The Gorilla monochrome monitor is excellent for home use and quite acceptable for commercial use. The display is crisp and clear. I tested the monitor with an IBM PCjr. The resolution was very good on 40-column, 80-column, and reverse video. The brightness and contrast controls allow a wide variation in adjustment. The anti-



Gorilla Monochrome Monitor. Courtesy of Leading Edge Products, Inc.

glare screen reduces reflection, but the reduction is not as great as with some monitors, for example, the Amdek Video-300A.

A fold-down bracket under the chassis allows the user to tilt the screen. Controls on the front include on/off, contrast, and brightness. Control knobs on the back are for horizontal size, vertical size, and vertical hold.

The one-year warranty includes parts and labor. Leading Edge also provides a toll-free number (800-343-6833) plus a special service hot line number (800-343-6857). This is exceptionally good support.

The documentation consists of an 8-page manual which has little information to help the technician or installer/merchant. The user, however, should have little difficulty since the monitor is quite easily installed and adjusted.

SUMMARY

The Gorilla monitor is excellent for home use and very good for commercial use. Characters are crisp and clear and the antiglare screen is helpful. The resolution is quite high. For about $100, this monitor is hard to beat.

TR-120-MDPA AMBER MONITOR AND TR-120-MIPA GREEN MONITOR

Panasonic Industrial Co.
$249

PERFORMANCE RATING
Performance: Excellent
Documentation: Good
Ease of Use: Good
Usage: Commercial/Home - Excellent

FEATURES
12-in. amber or green monochrome display
Nonglare screen
Composite video input and output
(daisy chain, several monitors)
Audio input
RCA phono plugs
Dimensions: width 13.75 in. × height 11 in. × depth 14 in.
Weight: 18 lbs.
Options: Swivel base - $25.99

Panasonic monochrome monitors produce a very fine character display for high CRT usage applications such as word processing. The model I examined displayed black characters on an orange background (reverse video) in 80 columns. The antiglare screen is designed to reduce eyestrain, and the elegant optional swivel base positions the unit for comfortable viewing.

The front panel has knobs for on/off, contrast, and brightness control. The three phono plugs are located on the back. The video in and video out feature allows chaining a series of monitors together so a number of users can see the same display—especially useful in classroom situations. The audio capabilities equip this unit for use with home and game computers. The documentation consists of one sheet with hookup instructions. It's not elaborate but well written and illustrated.

This unit is especially compact and lightweight. Unfortunately, Panasonic didn't design it with a handle.

SUMMARY

The Panasonic amber and green monochrome monitors are excellent. Even though they have audio output, the price seems a bit high, considering the quality of the Amdek and even the $100 Gorilla monitors. The optional swivel base is a definite plus.

Color Monitors

AMDEK COLOR I PLUS COMPOSITE MONITOR

Amdek Corp.
$449

PERFORMANCE RATING
Performance: Good
Documentation: Good
Ease of Use: Good
Usage: Home – Good; Commercial – Fair

FEATURES
13-in. nonglare screen
Composite video input
Audio input, speaker, and headphone jack
Standard RCA phono plugs for video and audio input

Amdek Color I Plus Monitor. Courtesy of Amdek Corp.

The Amdek composite color monitor has an excellent quality picture, and produces a legible 40-column display. The color bars are true and sharp, as shown on a color bar chart. The built-in speaker is handy for computers that don't have on-board speakers, for example, the IBM PCjr. The reverse video is a bit difficult to read. It doesn't compare to the RGB Amdek Color II Plus, which produces an excellent 80-column display.

The speaker, pull on/off control, and volume control are on the front panel. Hidden behind a snap-open cover are the vertical hold, color, tint, and brightness adjustments. The case has a molded carrying handle. The overall size of the Color I Plus is similar to the Color II Plus. It is bulky, heavy, and not particularly portable.

The two monitors I reviewed had wavy vertical lines, and the white letters had other colors contaminating them. Apparently, the convergence was off. Another, older monitor which belonged to a friend of mine had very good quality white letters. The buyer should make sure that the store adjusts the monitor before delivery.

SUMMARY

The Amdek composite monitor is very nice. The colors are true and the 40-column display is quite legible. The monitor isn't adequate for 80-column displays and is marginal for reverse video use.

AMDEK COLOR II PLUS RGB MONITOR

Amdek Corp.
$529

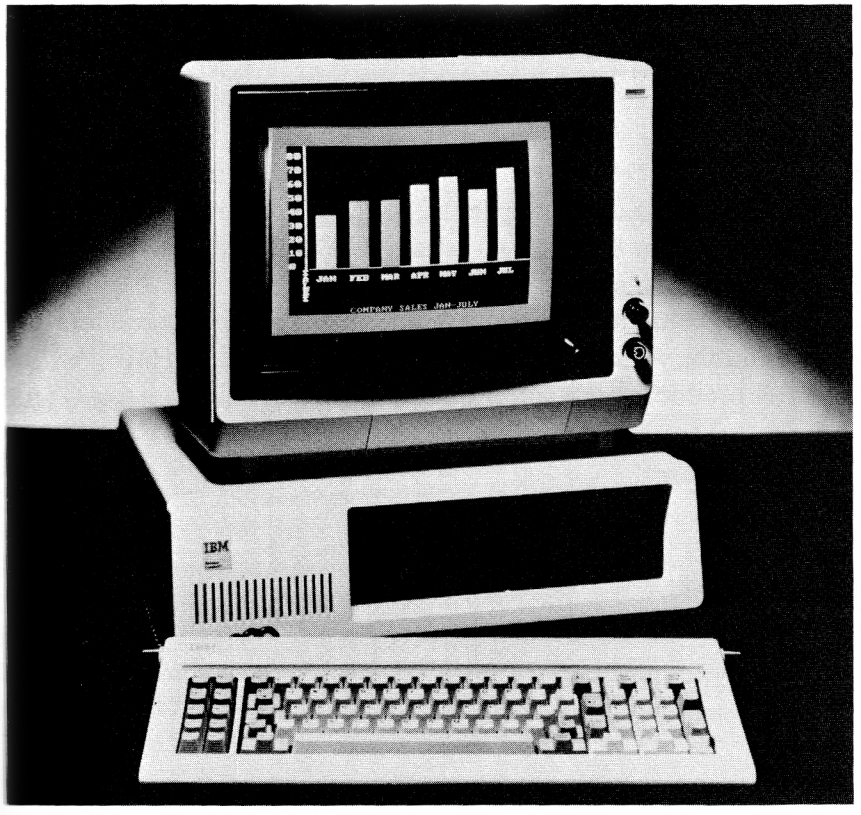
PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Good; Hacker - Good
Ease of Use: Excellent
Usage: Home - Excellent; Commercial - Excellent

FEATURES
RGB color display
12-in. screen
Resolution: Horizontal 560 dots × vertical 240 lines
Character Display: 80 characters × 25 lines
Dimensions: length 16 in. × width 17 in. × height 15 in.
Weight: 14.5 lbs.

The Amdek Color II Plus RGB (red-green-blue) monitor produces one of the best pictures available in color. The characters are easy to read, even in an 80-column width. The white is white, and there is no bleeding or halo around the characters to distort their shape or clarity. The dark shadow mask around the screen increases contrast and makes viewing the screen more comfortable. When the room was light, I could easily see my image reflected back to me. The monitor would be improved with the addition of a nonglare screen.

I would not recommend the RGB monitor for heavy word processing, where the user is constantly reading an 80-column screen. However, if the user needs a color monitor and an occasional 80-column display, the Amdek Color II Plus is an excellent buy. I used this monitor with a 40-column word processor and could read the text quite comfortably. In fact, I used it in a small classroom environment and people could read the screen from 6 to 10 feet away.

The colors are vivid and the control allows a lot of adjustment. A hinged door on the front panel conceals the vertical hold and brightness controls. The contrast control and power on/off are located to the right of the screen. The contrast adjustment is not as great as that of the TAXAN RGB 420 monitor. The color test pattern generated by the IBM PCjr demonstrated that each monitor produces vivid colors. The TAXAN, however, produces more saturated color, which appears to have less gray or white mixed in. Amdek



Amdek Color II Plus Monitor. Courtesy of Amdek Corp.

monitor characters seem crisper and easier to read than TAXAN's, which appear to be a little fuzzier.

The monitor is bulky and rather large, compared to the IBM and some other RGB monitors. I would not call this monitor portable even though it is equipped with a handle.

The manufacturer offers a one year warranty for parts and labor. The customer must pay the freight and charges if the monitor is sent back to the factory.

The documentation is brief but adequate, even for the novice. We plugged the monitor into the RGB adaptor cable for the IBM PCjr without any modification. The manual also has a troubleshooting guide that indicates the required input signals. A detailed schematic lists part numbers and waveforms for alignment. Any good technician could repair this unit with the documentation provided.

Many dealers recommend this monitor to their customers because of its excellent display and reliability.

SUMMARY

The Amdek Color II Plus monitor is one of the best RGB monitors available for use with home and small-business computers. RGB monitors are not designed for heavy 80-column display use. Still, the characters are clear and readable. In the 40-column mode the text can be read from 6 to 10 feet away. The colors are vivid and the contrast good. This is an excellent color monitor for users needing both an 80-column text and a color display. The characters are sharper on the Amdek than on the TAXAN RGB 420. However, the TAXAN produces more saturated (more vivid) colors.

BMC COLOR MONITOR MODEL BM-AU9191U

BMC USA, Inc.
$349

PERFORMANCE RATING
Performance: Good/Fair
Documentation: Novice - Good; Hacker - Excellent
Ease of Use: Novice - Good; Hacker - Good
Usage: Home - Good

FEATURES
13-in. color display
Composite signal input
Cord with 2 RCA phono plugs at each end
Audio and video input ports
5 × 7 dot character
Display: 40 columns × 25 lines (1000 characters)
3 in. (8 cm) speaker
Dimensions: width 14 in. × height 13 in. × depth 15.5 in.
Weight: 22.5 lbs. (11.1 kg)

The review of this monitor must be tempered by the fact that it typically sells for about one-half the cost of most color monitors. In addition to video output, the monitor has an audio output. Audio capability is an added plus to home-computer enthusiasts who use computers such as the IBM PCjr, which has a nonstandard internal audio speaker. Most monitors lack audio sound systems.

I tested this monitor with an IBM PCjr monitor test program and compared the display to that produced by the TAXAN RGB 420—a tough competitor.

Total Control

The seven adjustment knobs, recessed under the screen, are a bit hard to reach, but this protects them from small fingers and accidental movement. Large knobs allow the user to adjust vertical-hold, horizontal-center, brightness, contrast, tint, color, and volume. Most of the monitors reviewed have only the brightness and contrast controls located on the front, with the other controls at the back. The tint controls are a mixed blessing since the user needs a good, labeled, color test pattern to properly set the color balance.

Graphics Good and Text OK

Since the monitor doesn't have an antiglare screen, glare and lighting should be controlled. After considerable adjustment, the monitor would not produce a pure yellow. The yellow and brown color bars were tinted green. The other colors seemed close to true, with some shifting of the blue toward green. The convergence seemed a little off, since a yellow line appeared at the far-left picture margin and a blue line at the far-right margin. This could also account for some of the fuzziness and color shift. Color bars tended to bleed slightly into the next color, and the background, which should have been black, was dark gray.

The characters displayed in the 40-column mode were clear and easy to read. The 80-column mode text was difficult to read. Reverse video in 40 columns was clear, while the 80-column was very difficult to read. The 640 × 200 test-pattern grid was fuzzy.

Adequate Documentation

The manual is a fold-open sheet which tells the user most of the information needed. The manual states that the tint control knob controls tint; the color control knob controls color, and so on. This doesn't offer much help to most users. The manual shows the ports for both audio and video input, but doesn't say whether the red- or black-wire lead is audio or video. When the video lead is plugged into the audio port, the speaker buzzes. You can hear what a picture sounds like—I guess.

Hackers will appreciate the complete schematic that lists part numbers and oscilloscope wave forms. Any good technician could repair this monitor with standard parts.

Service Is a Mystery

The address and telephone number listed in the manual for BMC International is in Japan. No U.S. distributors or service centers are listed. The 90-day warranty states that the unit should be returned to the place of purchase. Since this unit is sold by many discount outlets, the method for honoring the warranty may vary with store policy. The buyer should inquire about this before purchasing the unit.

SUMMARY

Considering its low price, this composite color monitor is worth a close look by home users. Its ability to reproduce sound is unique among monitors. The 80-column text was difficult to read, while the

40-column text had good definition. The picture quality is good but not close to that produced by the TAXAN RGB 420 monitor. The colors were not as accurately reproduced and the picture was not as sharp as in expensive monitors. However, since the BMC typically sells for almost one-half the price of many other color monitors, it is a good buy for home users.

QUADCHROME RGB COLOR MONITOR

Quadram Corp.
$795

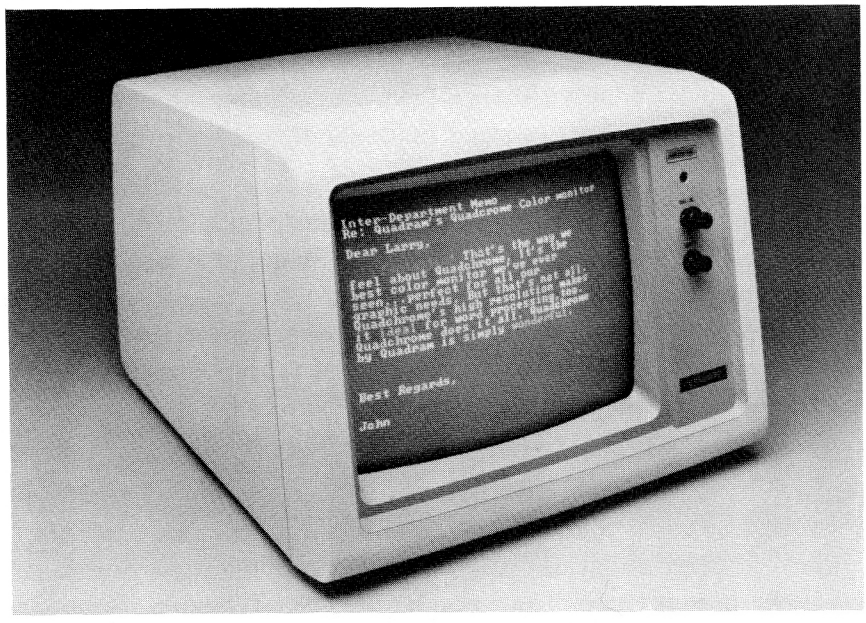
PERFORMANCE RATING
Performance: Excellent
Documentation: Good
Ease of Use: Excellent
Usage: Home/Commercial - Excellent

FEATURES
12-in. antiglare screen
RGB video input
690 horizontal × 480 vertical dot resolution

The Quadchrome RGB color monitor has a very sharp picture and excellent color. The colors are true, as measured on a color-bar chart. The 40 column, 80 column, and reverse video displays were very sharp.

The monitor has ventilation holes at the back and top so objects should not be placed on top of the monitor. The pull on/off and brightness controls are located on the front panel.

Quadchrome Monitor. Courtesy of Quadram Corp.



Adjustments at the back of the unit include vertical hold, horizontal hold, and vertical size. The unit is compact in size, but doesn't have a molded handle for porting.

SUMMARY

The Quadchrome RGB color monitor has an excellent display in both 40- and 80-column modes. Reverse video is easy to read in 40 and 80 column. This is an excellent monitor for either home or business use.

SAKATA SC-100 COLOR MONITOR

SAKATA USA Corp.
$325

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Excellent; Hacker - Fair
Ease of Use: Good
Usage: Commercial - Fair; Home - Good

FEATURES
13-in. diagonal screen
Data Signal: Composite video
Ports: 2 RCA phono plugs (audio and video)
Resolution: 230 lines horizontal × 300 lines vertical
Characters: 1000 (5 × 7 dots; 40 columns × 25 lines)
Color: 8 colors minimum
Audio output
Dimensions: width 14.5 in. × depth 17 in. × height 14 in.
Weight: 31 lbs.
Options: Tilt/swivel base ($49)
Compatibility: Apple II, Atari-800, Commodore-64, IBM-PC, NEC-PC, Osborne, TI-99, VIC-20, and Fujitsu

SAKATA SC-100 Color Monitor. Courtesy of SAKATA USA Corp.

The SAKATA SC-100 13-inch monitor is a good composite monitor for home and some business applications. The color is very good. The 40-column text is very legible; however, since 80-column text is not recommended, some business applications would be limited. The nonglare screen dampens reflections.

The contrast and sound controls (thumb wheels) are located on the front. Also on the front is the power switch and a phone jack. Color, tint, and brightness controls are located on the upper-back panel. To reach these controls, I had to stand, which was a little inconvenient. Operating the controls from the back and watching the screen in front was awkward. The user needs a special tool to access the recessed controls for horizontal hold, focus, horizontal shift, vertical hold, and vertical height. The manual suggests that these only be adjusted by a repair facility.

The monitor has a built-in speaker which would be beneficial to computers that need speaker output, the IBM PCjr, for example.

The owner's manual is very good. It includes a troubleshooting chart for nonstandard signals and explains preventive safety and maintenance measures.

An optional tilt/swivel base is available and would be an asset to many users.

SUMMARY

The SAKATA SC-100 composite color monitor is good for users who require color and a 40-column display. This will limit business use, which frequently calls for 80-column displays. The monitor has an on-board audio system for reproducing sound. The documentation is good for novices.

TAXAN RGB VISION 420 COLOR MONITOR

TAXAN Corp.
$699

PERFORMANCE RATING
Performance: Excellent
Documentation: Fair
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home/Commercial - Excellent

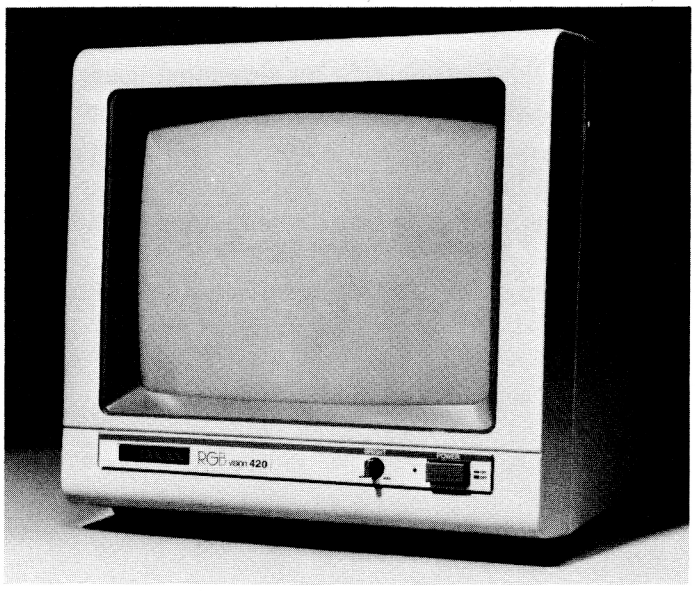
FEATURES
12-in. display
Antiglare screen
Characters: 5 × 7 dots; 80 columns × 25 lines
Resolution: 640 lines horizontal (high)
Input Signal: RGB separated signal
Dimensions: width 12.5 in. × height 12 in. × depth 15.5 in.
Weight: 26.5 lbs.

The TAXAN RGB 420 color monitor passed the display tests on the IBM PCjr with flying colors (no pun intended). I compared the display with the Amdek Color II Plus and was hard pressed to distinguish between them.

The TAXAN color monitor produces more intense or saturated colors than the Amdek Color II Plus monitor—the green is greener, the red redder, and so on. The color bars are true and very clear. The margins between the color bars were a bit blurred. However, the red and red-orange bars are indistinguishable from one another.

TAXAN blurs the dots within characters, and thus they appear more solid. However, this tends to make them look a bit fuzzy compared to the crisp characters displayed by the Amdek Color II Plus monitor. Both monitors were excellent in 40-column display, but the Amdek Color II Plus monitor was a bit easier to read in 80 columns. TAXAN's antiglare screen is a definite plus in a brightly lighted room.

The front panel has a push on/off button and a brightness control. An LED power indicator shows when the monitor is on; however, it is so small that I often overlooked it. Controls on the back allow the user to adjust horizontal size, horizontal position, vertical size, vertical hold, horizontal hold, and vertical position. There is also a focus knob. The controls on the back may only be accessed with an



TAXAN RGB Vision 420 Color Monitor. Courtesy of TAXAN Corp.

insulated screwdriver/alignment tool. The monitor does not have a contrast control.

Two types of input plugs are provided: a DIN connector and an 8-pin rectangular connector. A mode switch allows the user to select between three configurations for IBM PC; Apple II and NEC; and Apple III. The manual indicates settings for other computers also.

The manual labels the signals on all eight pins for troubleshooting. It also has a troubleshooting guide that indicates which adjustment controls address which problems. In general the manual is adequate, though the hacker will miss not having a schematic.

The overall compact size of the monitor makes it relatively portable, even though no handle is provided. The 12 in. TAXAN is much easier to transport than the bulkier Amdek Color II Plus monitor.

Color Graphics or Text?

If the user is primarily interested in graphics and games, TAXAN will give a more vivid and intense color display than the Amdek Color II Plus monitor. If the user plans to run applications that require reading a lot of 80-column text, the Amdek Color II Plus monitor or a monochrome monitor might be preferable. (See also the review on Amdek Color II Plus monitor.)

SUMMARY

The TAXAN RGB Vision 420 is an excellent color monitor. The focus is not as sharp as that of Amdek Color II Plus, although if they

weren't sitting side by side most users would never notice such a fine difference. The colors are excellent and true. The compact design makes this monitor relatively portable, even though it has no handle. The antiglare screen reduces reflections in a bright room. Overall, this is an excellent color monitor.

Terminals

QUME QVT-102, QVT-103, AND QVT-108 TERMINALS AND QVT-211GX GRAPHICS TERMINAL

Qume Corp.
QVT-102: $695; QVT-103: $1095; QVT-108: $895; QVT-211GX: $1295

PERFORMANCE RATING
Performance: Excellent
Documentation: Good
Ease of Use: Excellent
Usage: Commercial - Excellent

FEATURES
Display Format:
All Models: 25th status line display
Model-102: 24 lines × 80 columns
Model-103: 24 lines × 80/132 columns
Model-108: 24 lines × 80 columns
Model-211: 24 lines × 80 columns
Character Formation: 7 × 9 matrix; 9 × 12 cell
Resolution: Model 211 - 644 × 288
Interface: RS-232C serial
Baud Rates: 16 selections from 50 to 19.2K bps
Screens:
All Models: Tilt/swivel base
Model 102: 12 in. nonglare green monochrome (amber, optional)
Model 103: 14 in. nonglare green monochrome (amber, optional)
Model 108: 12 in. nonglare monochrome green (amber, optional); with 14 in. nonglare amber, optional
Model 211: 14 in. nonglare green monochrome (amber, optional)
Character Attributes:
All Models: Blink, blank, underline, reverse video, half intensity
Auxiliary Port:
Model 102: Unidirectional RS-232C, partial/full screen copy
Model 103: Bidirectional RS-232C, buffered, screen copy
Model 108: Bidirectional; Modes: parallel, transparent, screen copy, RS-232C serial.
Model 211: Bidirectional RS-232C; partial/full screen copy
Detachable Keyboard:
Model 102: Numeric pad, 4 function keys (12 functions), defeatable auto repeat and key click

Model 103: Numeric pad, 4 function keys (12 functions), defeatable auto repeat and key click
Model 108: Numeric pad, 11 function keys (22 functions), defeatable auto repeat and key click, 12 editing keys
Model 211: Numeric pad, 12 function keys (8 programmable), defeatable auto repeat and key click

Emulations:
Model 102: Hazeltine 1500, Lear Siegler ADM-3A/5, Televideo 910
Model 103: Digital VT52, VT100, VT131
Model 108: Televideo 925, Televideo 912/920
Model 211: Tektronix 4010 and 4014 command sets, Hazeltine 1500, Televideo 910, Lear Siegler ADM-3A/5

Software:
Model 211: PLOT-10 compatible subroutines which speed development of graphics applications, from Tektronix Corp.

Graphics Features:
Model 211: Full, interactive vector graphics; separate display memory for graphics; absolute and relative addressing; draws lines, boxes, arcs, and circles; area fill; cross-hair cursor

Dimensions:
All Models: Approx. 14 in. × 13 in. × 12 in.

Weight (including keyboard): All models approximately 22 lbs.

Qume QVT terminals allow businesses to choose compatible CRTs for almost any job. The specialized graphics terminal can be used with both business and technical applications. A green or amber tilt/swivel screen, a large 9 × 12 character cell, and a detachable low-profile tilt keyboard make using these terminals pleasant and comfortable.

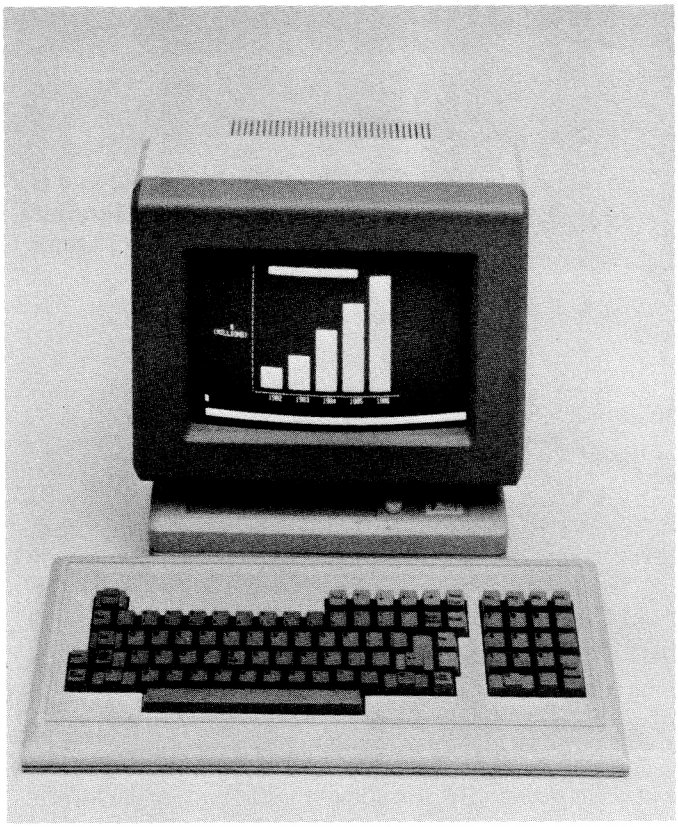
Qume recommends the QVT-102 for a clerical workstation. It has all the features of the Hazeltine 1500, Lear Siegler ADM 3A/5, and Televideo 910 plus features found in higher priced terminals. The QVT 102 has block and conversational modes, local editing, a 25th status line display, a menu set-up mode, eight user-programmable functions, four preprogrammed functions, and a bidirectional auxiliary port.

The QVT-103 emulates Digital's VT 52, BT 100, and VT 131 terminals. In addition, Qume provides a 14-in. screen, 14 editing keys, 12 user-programmable functions, two pages of screen memory (expandable to four), and a user-defeatable status line.

The QVT-108 has the flexibility to handle everything from routine

Qume QVT-103 Terminal. Courtesy of Qume Corp.

Qume QVT-211GX Graphics Terminal. Courtesy of Qume Corp.



Qume QVT-102 Terminal. Courtesy of Qume Corp.

order entry to management-level tasks. It has 22 user-programmable functions, 12 editing functions, a user-defeatable 25th status line, a menu set-up mode, and two full pages of screen memory. An optional 14-inch display is available.

The QVT-211GX is the best choice for business and technical graphics. It delivers advanced vector graphics including arcs, circles, lines, and boxes. Since it emulates the Tektronix 4010 and 4014 command sets, it's ideal as a preview terminal for CAD/CAM applications.

SUMMARY

The Qume terminals all have excellent displays and keyboards. The swivel/tilt screens are exceptionally nice and the units are very attractively designed. Anyone needing a terminal should look at the Qume products before making a decision.

TELEVIDEO 925 TERMINAL

TeleVideo Systems, Inc.
$890

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Good
Usage: Commercial - Good

FEATURES
12-in. green monochrome display
Nonglare screen
80 characters by 24 lines with 25th status line display
1920 characters per screen
7 × 8 dot matrix; 8 × 10 resolution (640 × 240)
Blinking, blanking, reverse video, underlining, half intensity
10 key numeric keys
20 cps auto repeat
Editing capabilities
Baud Rate: 15 rates from 50 to 19,200
Interfaces: RS-232C point-to-point; RS-232C printer port (bidirectional)
Dimensions: Cabinet width - 16.5 in. width × 14 in. depth × 14 in. height;
Keyboard - 16.5 in. width × 7.5 in. depth × 3 in. height
Weight: Cabinet - 30 lbs.; Keyboard - 4.5 lbs.

The TeleVideo Model 925 intelligent terminal provides a wide variety of functions and professional-quality performance. It can function as a terminal for a personal computer as well as independently. For example, the terminal alone can be connected to an auxiliary serial printer to make a permanent hard copy of data displayed on the screen. A two-page memory is optional. The terminal has internal software (ROM) that allows it to perform editing and cursor control, for example, line insert/delete, character insert/delete, line scroll, up/down/right/left cursor movement, home, tab, back tab, return, line feed, and backspace. The 20-cps auto repeat key allows quick insertion of dots, dashes, and other characters.

The green monochrome screen is surrounded with a black frame for easy viewing. The characters are well defined and have true descenders. The reverse video is also very sharp.

In block mode, the user can enter and edit data on the screen until it's complete and correct. The terminal can then be commanded to send the complete screen to the computer. This is useful when filling out forms or creating records. All corrections can be made before transmission. Conversation mode allows two-way transmission between the screen and computer. Half-duplex mode sends keyboard entries to the screen and to the computer at the same time. Full-duplex mode sends keyboard entries to the computer only. The computer may echo the result back to the screen, depending on the application program in use.

The screen can display blinking characters, underlined characters, half intensity characters, reverse video (black characters on bright background), and security (blank) fields. These capabilities permit the user great flexibility in operation.

Efficiency-Oriented Keyboard

The separate keyboard is similar to a standard typewriter's; moreover, the many function keys make operation efficient and straightforward. The touch is a bit harder than that of a fine-quality electric typewriter. Eleven function keys (F1, F2, . . .F11) are located on the top row. Also on the top row are character insert, character delete, line insert, and line delete function keys. Above the ten-key pad located on the right of the keyboard are three additional function keys: line erase, page erase, and send (block mode). The ten-key pad has a minus sign and enter key, but the user must use the plus sign on the alphabet keyboard.

When not in use, the keyboard may be pushed back under a slightly recessed area below the screen to reduce the footprint size of the terminal. An optional clicker can be turned on or off.

Versatile Hardware Design

At the back of the cabinet is the contrast control, fuse, voltage selector (110V or 230V), and power on/off switch. Two DIP switch banks control the baud rate and the functions (defaults) such as reverse video, duplex mode, parity, and terminal emulation (Models 912 or 920). These functions may also be controlled from the keyboard. The ports include the keyboard port (modular telephone plug), RS-232C printer port (direct connection to printer), and RS-232 point-to-point port. The baud rates are 50, 75, 110, 135, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600, and 19,200.

The screen may be tilted up with a supporting leg. However, the

terminal I reviewed no longer had this leg because it had broken when the owner pushed the terminal on the table.

This Manual Is the Best

The 35-page manual is the best I've ever seen for a terminal. The detailed table of contents and index guide the user to any subject of interest. The manual gives a good introduction in how to install the terminal.

Programmers are provided with a table of codes and instructions for configuring the function keys. The manual also explains the cursor-addressing codes and tells how to protect fields on the screen, how to use full/half intensity, underlining, blinking, and so on.

An excellent preventive maintenance, troubleshooting, and repair chart aids the user and the repair station.

Quick reference charts for command codes, switch settings, and common terms will guide more experienced users to needed information. A two-page glossary is fairly complete.

Warranty Extendable

The 90-day warranty is extendable for $75 per year and may be renewed each year.

SUMMARY

The TeleVideo 925 intelligent terminal is one of the best. The display is clear, the keyboard is designed for efficiency, and the versatility is high. The manual is one of the best I've seen for both the novice and the experienced computer user. The professional user will want to give this terminal strong consideration.

Remote Terminals/Keyboards

KB-5150 KEYBOARD FOR THE IBM PC AND KB-5151 jr KEYBOARD FOR THE IBM PCjr

(Models also available for DEC VT-100; Radio Shack TRS-80 Color Computer; Apple II; and TeleVideo-925)
Key Tronic Corp.
$255

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Excellent
Usage: Home/Commercial - Excellent

FEATURES
Familiar typewriter key locations and legends
Separate numeric, cursor, and function keys
Function keys located across top of keyboard
Home keys for F and J index-finger locations and 5 in the numeric keypad
Full travel keys
LED Status Indicators: Caps lock, cursor pad, number lock
Pop-up legs to tilt keyboard
Cable: 6 foot, coiled
Dimensions: length 20 in. × depth 8.6 in. × height 1.5 in.
Weight: 6 lbs.

For $255 the KB-5151 jr keyboard converted my $1500 PCjr into a $3000 computer. Now I can word process at the office on my IBM PC Portable, slip the disk out, take it home, slip the disk into my PCjr and continue working after dinner. The only real problem I have is returning to work the next day and adjusting to my less-wonderful IBM keyboard.

Comparing the Key Tronic KB-5151 to the PCjr keyboard would be unfair. The PCjr keyboard has no ten-key pad but does have a cursor control pad. The function keys require that the user press FUNCTION and then a number (1, 2, 3, etc.) to indicate which function is needed. No LED indicator is provided to alert the user of the CAPS LOCK status.

Comparing the Key Tronic KB-5151 to the IBM PC Portable keyboard seems a bit more fair. But even with this stiff competition from Big Blue, Key Tronic comes out way ahead.

IBM PCjr Keyboard by Key Tronic. Courtesy of Key Tronic Corp.

The Key Tronic keyboard offers many convenient features to the word processing touch-typist. The RETURN key and the SHIFT keys are in familiar locations and are easy to reach. Since the CAPS LOCK key's LED lights up, the user knows at a glance the status of the keyboard. The CURSOR PAD key with an LED indicator turns the cursor control pad on and off. When activated, the user can use the cursor pad to control cursor movement and the separate number pad to enter numbers. The Key Tronic ten-key pad has PLUS, MINUS, and ENTER on the far right margin of the number pad. The IBM number pad provides only PLUS and MINUS, without ENTER.

IBM PC Keyboard by Key Tronic. Courtesy of Key Tronic Corp.

The IBM Portable keyboard, which has a combined cursor control and number pad, requires shifting to get numbers instead of cursor movement. If the NUMBER LOCK key is activated, the portable normally types numbers and a shift lets the number pad move the cursor. The Key Tronic keyboard with two pads is more flexible and requires less work to operate.

The ten function keys are grouped in two sets of five, positioned above the row of numbers. The user can conveniently reach above home row without repositioning the left hand to the far left margin, as is necessary with the IBM PC keyboard. The new PAUSE key duplicates the IBM's CTRL/NUMBER LOCK combination, and CTRL RESET duplicates CTRL/ALT/DELETE, which signals a warm boot.

The Key Tronic keyboard sits at a comfortable angle due to the pop-up legs at the rear. The coiled cord is out of the way or may be stretched to put the detachable keyboard on your lap. At this time Key Tronic is looking into a cordless version.

The documentation is clear and well illustrated. Key Tronic explains the differences between the PCjr and the KB-5151 so the user will be able to take advantage of the enhancements. The manual is written at an adult reading level.

SUMMARY

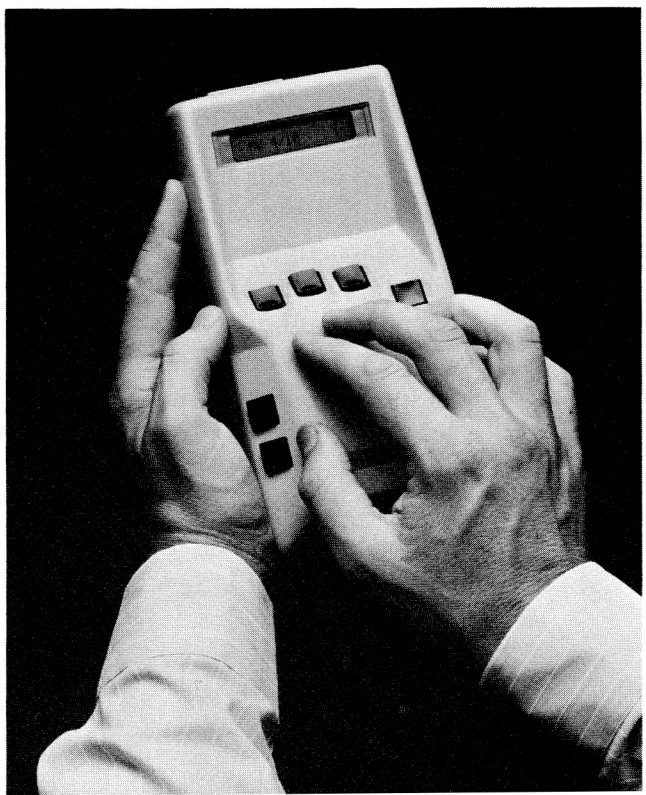
The Key Tronic keyboard for the IBM PCjr is one of the finest computer or typewriter keyboards I've ever used. The position of the keys is natural, the LEDs inform the user of the keyboard status, the cursor control pad eliminates shifting between numbers and cursor control, and the touch is light. Adding this keyboard to my PCjr gave a new dimension to its usefulness as a multipurpose computer capable of performing most of the functions of the more expensive IBM PC.

MICROWRITER

Microwriter
$499

PERFORMANCE RATING
Performance: Good
Documentation: Good
Ease of Use: Good
Usage: Home - Good; Commercial - Fair

FEATURES
Keyboard: 5 finger, with sixth command key
Display: Liquid Crystal Display (LCD); 14 characters (plus two status characters);
Uppercase/lowercase
Auxiliary Display - Optional monitor (no television)
Text editing: Print formating
Memory: Nonvolatile; 8045 characters (1600 words)
Interface: RS-232C serial; Data socket for cassette storage
Auxiliary Storage: Cassette (optional)
Batteries: Rechargeable nickel cadmium
Dimensions: length 9 in. × width 4.5 in. × depth 2 in.
Weight: 1.7 lbs.
Leatherette carrying case



The Microwriter. Courtesy of Microwriter

The Microwriter is a unique auxiliary terminal or stand-alone word processor. It's the size of a Princess-style telephone and comfortably contoured for the right hand. The user's fingers operate four keys across the top. Two keys are located in the proximity of the thumb. A 16-character LCD allows the user to view text as it's entered and to edit. Fourteen of the characters represent text, and two characters display the mode in which the device is operating.

Each key does not represent a unique character. Instead, a combination of keys represents the shape of a letter. For example, the letter "Y" requires the user to simultaneously press the thumb, the middle, and ring fingers. The letter "n" requires pressing all of the four fingers that form an arch. The "f" requires pressing the thumb and the next three fingers (omitting the little finger). The manual and reference sheets explain and illustrate finger positioning quite clearly. I asked two people to use this unit. A touch typist had difficulty learning the finger positions. A one-armed, hunt-and-peck typist thought the Microwriter worked well and was surprised that he and his ten-year-old daughter still remembered the finger positions a day or so later.

Microwriter claims that the user can enter text with this device at about one-and-one-half the speed of normal handwriting. It isn't meant to replace a standard keyboard; but the Microwriter fills a real need for an extremely portable terminal or for one-handed operation. The user can enter data in the field and dump the data through the RS-232 port into a larger computer at home or at the office.

The documentation is quite good. The new User's Guide is well illustrated and has humorous anecdotes to lighten the material. The General Systems Manual gives further information about formatting text, communications, and technical specifications.

The liquid crystal display (LCD) produces characters with true descenders; although, the display is a bit difficult to read. Editing with only a 14-character display is somewhat cumbersome. The manufacturer cautions against using the Microwriter with an auxiliary U.S.-made television display. Microwriter sells a separate adapter to support a monitor.

The nonvolatile memory will retain up to 8045 characters even after the unit is turned off. Data may also be transferred to cassette tape or printed for long-term storage.

SUMMARY

The Microwriter is a uniquely designed stand-alone word processor or auxiliary terminal. It can be operated with one hand at approximately one-and-one-half the speed of normal handwriting. The 14-character LCD readout is limited and a little difficult to read. The documentation is good. Some people find the finger positioning techniques difficult to use and others find it rather natural and easy to remember. The 8045-character nonvolatile memory makes the Microwriter ideal for field work. Handicapped people who have the use of their right hand might find Microwriter a viable alternative to the standard QWERTY keyboard.

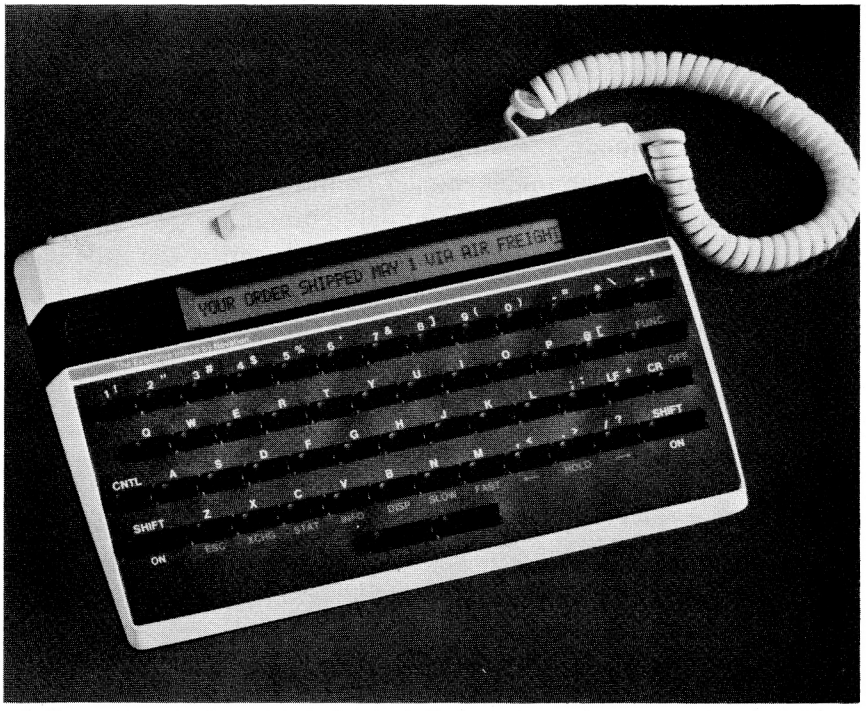
INFONE - MAXI, EXECUTIVE, AND PROGRAMMABLE MODELS

Novation, Inc.
Maxi: $1150; Executive: $995; Programmable: $1000 (estimate)

PERFORMANCE RATING
Performance: Good
Ease of Use: Good
Usage: Business - Good

FEATURES
Keyboard: Standard typewriter with chiclet keys; Uppercase/lowercase, function keys
Character Set: Full ASCII
Display: 1 line 40-character LCD; 5 × 7 dot matrix
ROM: 32K bytes
RAM: Executive - 2K bytes; Maxi and Programmable - 6K bytes
Modems: 1200 baud, 202 compatible; 300 baud, 103 compatible; All modems with auto answer
Interface: Serial RS-232C
Electronic Telephone: All-electronic telephone with condenser, microphone with AGC, electronic ring and sense of dial tone, busy, ring, and ring back
Audio Features: Built-in speaker, volume control, telephone handset, external speaker drive
Power: 5DC, 4AA nickel cadmium rechargeable batteries
Battery Life: 1 to 2 hours
AC Adapter, 115V
Time-of-day clock
Auto Dialer: Built-in pulse or touch tone/auto redial
Connectors: Modular jack to phone line; Modular jack to handset; RS-232C 25-pin female D-connector
Audio and Printer Output: 5-pin DIN
Tape Cassette Output: 5-pin DIN
Dimensions: width 10.75 in. × depth 7 in. × height 1.5 in.
Weight: 2.5 lbs.

Novation advertises Infone as "the portable electronic office." It is an intelligent portable computer terminal, modem, telephone, electronic mail center, electronic appointment book, message center, data entry device, remote inquiry station, telephone directory, and automatic dialer. It works with any modular telephone jack and



The Infone. Courtesy of Novation, Inc.

contains a fold-away acoustic adapter. All of this is built into a package the size of a notebook and weighs only 2.5 lbs.

The Infone will store and automatically alphabetize a personal telephone list of up to 200 names, numbers, and telephone charges. The user can create and edit messages, display files, and automatically send files to another device at a preset time. Infone will automatically redial a busy number until it gets through. The Electronic Calendar reminds the user of staff meetings and birthdays. A standard cassette recorder can be added for extra memory capacity. The Infone can also be used as an auto answer terminal to receive calls during the user's absence.

The Executive model stores up to 2K bytes in battery backed-up RAM. This is equivalent to approximately five single-spaced typed pages of text.

The text editor, which is permanently stored in ROM, allows the user to enter names, phone numbers, messages, and other notes. The user can move the cursor right and left in both destructive and non-destructive modes. The up and down arrows scroll through the information line-by-line.

The Maxi model comes with 6K of RAM, an acoustic adapter, a

handset, and a desktop stand that props the Infone at a convenient typing angle. The 6K RAM allows storage of approximately 6000 characters or 15 single-spaced pages of typed text.

The newest Programmable model contains a terminal program that uses single-letter calls (commands) to minimize space. The custom-designed language permits the user to program the modem to perform a series of actions. For example, a field salesperson can program the unit to dial a number from its directory; log-on per specified commands; find a document stored in its memory; transmit the document over the modem; receive information from the host computer at the other end; and log-off.

The Programmable model can be programmed to display a data entry form: a sales order blank, for example. When the field salesperson calls the host computer (an IBM PC with 256K and a $400 communications program), the Infone transmits the sales orders and receives mail and messages.

SUMMARY

The Infone is a unique and versatile remote terminal, telephone, and data communications device. It can be used to enter, store, and transmit data from the field to a host computer. It can automatically answer calls and perform other electronic mail functions. And it can store databases such as a phone list, a calendar, and sales order file. The chiclet keyboard and single-line LED display do not permit rapid data entry and text editing; however, this unit is an effective device for field data entry and electronic communications.

TYPECORDER PORTABLE OFFICE SYSTEM

Sony Corp. of America
$695

PERFORMANCE RATING
Performance: Good
Documentation: Excellent
Ease of Use: Good
Usage: Home - Good; Commercial - Good

FEATURES
Keyboard: Standard QWERTY
Display: LCD - One line of 40 characters
Battery: Rechargeable alkaline (5 hours of life)
Tape Drive: Microcassette - 2 track/1 channel
Recording Density: 50 pages/side of tape
Internal Memory: RAM - 2K; ROM - 8K (text editor)
Interface: RS-232C serial
Transmission Functions: To Sony acoustic coupler/communications printer interface
Audio Functions: Record, playback, fast forward, rewind, pause, stop (60 min. audio recording/dictation)
Dimensions: height 1.5 in. × width 11 in. × depth 8.5 in.
Weight: 3 lbs.
Options: Foot control unit, remote microphone, earphones, AC adapter, car battery cord, portable printer, acoustic coupler

The Sony Typecorder portable office system is notebook-sized, lightweight, silent, battery operated, and easy to use. The standard QWERTY keyboard provides easy data entry. The 40-character LCD display is easy to read; but the amount of text that can be viewed at one time is very limited.

In addition to serving as a remote terminal, the user may dictate notes on the cassette tape used for data storage. The microcassette tape (1 in. × 1.5 in. × 1/4 in.) holds 60 minutes of dictation or up to 100 pages of typewritten or digital information. The storage capacity is unlimited since the user can change tapes as needed. The one-page internal memory capacity (1780 characters) provides editing capabilities, although editing a large file may be tedious. The text editor stored in ROM permits the following editing and formatting operations: set left/right margin, set/reset tab, erase line, delete character, insert character, insert line, horizontal/vertical scroll,

Sony Typecorder. Courtesy of Sony Corp. of America

store data, and retrieve data from storage. Once the file is dumped into the larger host computer, the Sony SMC-70 for example, the user can process the data as needed.

The Typecorder can transfer digital data stored on the tape over an acoustic modem to the base computer. In addition the Typecorder can be connected directly to the host through an RS-232C port. A portable printer is also available for field use.

SUMMARY

The Sony Typecorder is a truly portable terminal. It has a standard keyboard for data entry as well as a microcassette tape for storing large volumes of audio and/or digital information. The unit also serves as a standard audio dictation machine. Data can be transferred to a larger host computer over an acoustic modem or directly through an RS-232C serial port. A built-in text editor allows basic editing in the field. The 40-character LCD display and 2K of internal RAM are limited; however, once the data is transferred to the host computer, it can be processed and manipulated more efficiently.

Chapter 3

Modems

A year or so ago most personal computer owners thought that owning a modem was a luxury. Now, modem sales are rising at an astounding rate. It seems personal computer users want to link their computers to the world. Hobbyists' bulletin boards and commercial database and electronic mail services are making the world of telecommunications both attractive and profitable.

What Can a Modem Do for Me?

Local bulletin boards provide computer club members a source for entertainment and information. A bulletin board, like a ham radio, allows enthusiasts to visit, express their opinions on world affairs, sell hardware, share software, help with technical problems, and generally have fun. The bulletin board is a personal computer (generally equipped with a hard disk for large storage capacity) which automatically answers telephone calls made to it. The bulletin board system (software) guides the caller through a series of menus and procedures that permit the caller to receive messages, leave messages, upload and download software, and perform a number of other tasks. Hobbyists with bigger budgets may use long-distance telephone service to call bulletin boards all over the country, thus creating a nationwide dialogue among personal computer users.

Database services allow the user to retrieve information from such sources as the Dow Jones News Retrieval Service, The Source, CompuServe, and Lexis. The personal computer user can receive up-to-date financial, legal, and weather information; look for a job;

research encyclopedias, libraries and news services; utilize complex and expensive mainframe computer hardware and software; and even access marine industry information. As more and more database services come "on-line" the advantages of owning and using a modem increase.

What Exactly Is a Modem?

A modem (*mo*dulator/*dem*odulator) is a device that converts (modulates) the computer's signals into a form that can be transmitted through common telephone lines. In this way the user can send electronic mail, information, and data to another computer miles away. On the receiving end, a modem converts (demodulates) the telephone signal into a form which the computer can understand. The two computers may be sitting next to each other, or they may be thousands of miles apart.

The computer needs communications software (instructions) before a modem may be utilized. Although this book will not evaluate terminal software, you should be aware that the features of the software and hardware selected should complement one another. The software may allow you to prepare text before making a costly telephone connection, provide a system for printing messages you receive, interpret (decode) control signals from one computer system to another, permit file manipulation and control, and detect transmission errors. If you buy the software and the modem from a dealer who is familiar with your computer system, you will improve the odds of getting a working system.

The first question you should ask is, "How do I plan to use my personal computer modem?" The following checklist may help in answering this question. When evaluating the features, you might rate them as essential (+++), desirable (++), and nice but can do without (+). In this way, you'll learn what compromises you might have to make.

1. How much can I afford to pay? _____
2. What computer am I going to connect it to? _____
3. Does my computer have a serial port? _____
4. Do I use rotary or touch-tone dialing? _____
5. What software will drive the modem? _____

6. To what will I want my modem to transmit? _____
7. How fast must it transmit? _____
8. How far must it transmit? _____
9. Is the environment I'm working in noisy? _____
10. Must the modem be portable? _____
11. Should the modem answer calls automatically? _____
12. Should the modem dial calls automatically? _____
13. Do I need to verify connection with my party? _____
14. Do I only want to send information? _____
15. Do I only want to receive information? _____
16. Do I want to send and receive information? _____
17. Do I want to send and receive information simultaneously? _____
18. Do I need a speaker to listen to the transmission? _____
19. Do I want to switch from data to voice transmission? _____
20. What is the short-term/long-term maintenance? _____
21. What warranty do I want? _____
22. What type of service do I need? _____

This chapter will help you find a modem that best meets your identified needs.

How Much Can I Afford to Pay?

Modems range in price from $75 to over $600. The cable needed to hook the modem to the computer may cost extra. Battery-powered modems may require that the batteries be purchased separately.

The number of features offered by the modem govern the price. Your application dictates which features are essential and which are just an added luxury. If you are transmitting critical information over long distances, both accuracy and high speed may be very important. If, however, you're "playing" on the local bulletin boards, high reliability and speed may not be vital. As a rule, high-speed and multiple-speed modems cost more. You should balance your requirements against your budget, as with any purchase.

What Computer Am I Going to Connect It To?

Most personal computers equipped with an RS-232C serial output port work with any standard modem. However, some modems may not require that the computer have an RS-232C serial port; for example, the Radio Shack Direct Connect Modem I, which is used with the Model I and Model III. Some modems are available as printed circuit cards that plug into slots in the computer; the IBM PCjr internal modem, for example. These in-board modems will not be discussed in this book since they are highly specific to a computer brand and model. Only external units will be covered in the product review section. Questions about modems designed for specific brands and models of personal computers should be directed to your dealer.

Does My Computer Have a Serial Port?

The RS-232C serial interface or port (plug) is an industry standard. Data moves through the serial interface bit by bit. That is, the electrical signals representing 0s and 1s (the binary code of the microcomputer) move single file through a single wire. Approximately 10 bits (0s and 1s) are needed to represent one character or symbol such as an "A" or "$".

The RS-232C interface will transmit data through a cable up to 50 feet long from 300 baud up to as high as 19,200 baud (bits per second). Most personal computers and modems transmit and receive data at 300 or 1200 baud (30 or 120 characters per second).

High-speed transfer requirements are being met with the new RS-449 interface that allows transmission up to 4000 feet at 100 Kbaud. At 40 feet, the RS-449 will transfer at a rate of 10 megabaud.

Common telephone communication lines that use switched or dial networks, effectively limit data communication to 2400 baud at full duplex (more about this below). Special dedicated transmission lines such as Direct Distance Dialing (DDD) and WATS (Wide Area Telecommunications Service) support a maximum of 4800 baud at half-duplex (more below). High-speed transmission schemes using satellite communications provide data rates from 10,000 bits to 1544 bytes per second, and are improving every month. (These products are outside the scope of this book.)

If your computer has an RS-232C serial port, you shouldn't have any difficulty finding a modem.

Do I Use Rotary or Touch-Tone Dialing?

Most modems are compatible with either dialing system. Since some are not, make sure the modem you select is compatible with your dialing system. This is especially important for auto-originate operations. (See the section on dialing calls automatically, page 161.)

What Software Will Drive the Modem?

Communication (terminal) software provides the personal computer with the instructions needed to interface (hook-up and communicate) with a modem. More sophisticated software allows you to perform many editing and formatting jobs before connecting to the receiving computer. Off-line preparation may save a lot of money for long-distance or time-sharing charges.

Some software may allow you to print incoming data as it is received. Highly sophisticated software may also provide translation tables which can convert control or special formatting codes from one computer system to another. Screen formatting allows you to format the line width so words are not split at the end of the line. The software may allow different screen line widths—32, 40, 64, 80. Scramble and password controls may be provided to protect sensitive data.

Access to disk operating system commands allows you to search the directory for files, copy files to disks, delete disk files, and perform many other functions during communication operations.

Above all, the communication software and modem documentation must be clearly written and contain useful examples. A poorly written manual is frustrating and makes using your modem difficult at best.

Many computer club, public domain, and software libraries have terminal programs available for under $10. The programs may not do everything you want, but a hobbyist with a small budget can at least get on-line.

To What Will I Want My Modem to Transmit?

Various communication schemes exist within the realm of data transmission. Communication software and the modem hardware must have the correct handshaking (procedures) or protocol to make a successful connection and data transfer. Check out what is re-

quired by the system to which you want to transfer. You may need a special black box, special software, passwords, and so on. (See the information on duplexing, page 162.)

How Fast Must It Transmit?

Most hobbyists communicate with bulletin boards at 300 baud (30 cps). Some bulletin boards and database services operate at 1200 baud, or four times as fast. More rapid data transmission results in lower long-distance telephone charges as well as a substantial reduction in your boredom coefficient. However, taking advantage of rapid transmission may require that you prepare the information before making the connection to the other computer—a software capability. (See the section on serial ports, above, for rapid data transfer configurations.)

How Far Must It Transmit?

Some personal computer users employ modems in local area networks (LAN); for example, communicating with a colleague in an office down the hall. The RS-232C interface will only support communication up to 50 feet away at rates of 9600 to 19.2K baud. Commercial and leased telephone lines can effectively expand data communications to anywhere in the U.S. Communicating outside the U.S. is difficult due to different standards, codes, and transmission techniques.

Is the Environment I'm Working in Noisy?

There are today two types of popular personal computer modems: the acoustic and the direct-connect modems. The acoustic modem makes the phone connection through the air by generating sounds or tones that are detected by a standard telephone handset mouthpiece. Although these modems have rubber cups that seal the phone headset, some environmental noise may interfere with and disrupt data transmission. Many people use acoustic modems and obtain high reliability.

In the past, acoustic modems were less expensive than direct-connect modems. Recently, however, the direct-connect modem has

become more competitive. It hooks the computer into the telephone network electronically. Thus direct-connect modems are not affected by surrounding noise from printers, talk, or office noise.

Must the Modem Be Portable?

You may prefer the acoustic modem for its portability. For example, traveling business people can always find a phone headset that will fit into the modem's rubber cups. However, finding a phone with a plug or jack that will connect to the direct-connect modem may be difficult. Modems that are built into a portable computer may be particularly convenient for the traveler.

Should the Modem Answer Calls Automatically?

Auto-answer modems detect an incoming call, answer it automatically, and perform the steps necessary to begin communication. The auto-answer feature is especially valuable for electronic mail applications in which you may wish to call and leave messages, orders, and data for the user when the terminal is unattended. Bulletin boards use auto-answer modems to connect with incoming calls from users.

Should the Modem Dial Calls Automatically?

You may like the convenience of dialing calls by entering the numbers on the computer keyboard or by selecting a party from a computer-generated menu. The communications software must also support this auto-originate procedure. Sophisticated systems may operate without your intervention and supply data at a preset time to another computer. For example, once an hour a remote-sensing station for the weather service might automatically dial to a central computer station and transmit its data.

Do I Need To Verify Connection with My Party?

Some modems are equipped with a carrier-detection indicator that signals when you have made a connection. With this feature you

don't need to pick up the telephone receiver or listen to the modem speaker (if it has one) to verify that a computer and not some puzzled individual is on the other end of the line. Also, if the other party disconnects, the modem senses a loss of signal. A carrier-detection signal may be the only way you can conveniently know that you've reached another computer and not a busy signal or wrong number.

Do I Only Want to Send Information?

Simplex or one-way communication is used for sending data and information in one direction only. Remote, unmanned data-gathering stations may use a simplex modem to send information—for example, to transmit weather measurements to a computer.

Do I Only Want to Receive Information?

Simplex communication is also used by a terminal that only receives information; for example, a terminal and modem that receive instructions.

Do I Want to Send and Receive Information?

Most hobbyists and business users want to have two-way communication. Half-duplex communication is similar to single frequency short-wave radio transmission. Both parties can talk and receive; however, only one at a time can transmit or receive.

Do I Want to Send and Receive Information Simultaneously?

Full-duplex communication is the most desirable. Data can be outbound at the same time that the equipment is receiving information. If a personal computer system is transmitting data to another, the other computer echoes the data to the sender. The echoed data is displayed on the sending screen for you to observe and verify. Terminal software may alert you to an error status. Thus the accuracy of the transmission can be monitored and validated. Echo-plex cannot occur in half-duplex operation.

Do I Need a Speaker to Listen to the Transmission?

One way to verify that proper connection has been made and is still in effect is to turn on a speaker resident in the modem. This can be especially handy for detecting busy signals and wrong numbers.

Do I Want to Switch from Data to Voice Transmission?

Acoustic modems must be removed from the headset before voice communications can be conducted. Direct-connect modems may be equipped with a switch that allows you to use the phone from voice or data transmissions.

What Is the Short-Term/Long-Term Maintenance?

Since modems have few if any mechanically activated parts, they rarely break. If a modem is vital to the operation of a database service, bulletin board, or business operation, a back-up or spare modem should be readily available for emergencies. References from modem owners and product reviews can provide valuable information on the performance and reliability of specific brands and models.

What Warranty Do I Want?

Ninety days is the most common warranty period. Make sure that the warranty covers both parts and labor. Check to see if local warranty service is available or if the modem must be shipped to an out of town service center. Freight charges will probably not be covered by the warranty.

What Type of Service Do I Need?

Find out what kind of service the local dealer provides. Does the dealer have factory trained technicians? Does the dealer stock parts? What is the service turn-around time and quality? References from the dealer's customers are important indicators of service. If the modem is vital, the best insurance for uninterrupted service is buying a spare. Find out if the dealer provides loaners or if you need to purchase an extra unit.

The Checklist Provides the Answers

Once the checklist is complete and rated for priorities, the type of modem required for the application will be clear. Compare these ratings to the following Product Reviews to determine which makes and models you should examine in person. Make sure that the features offered by the modem are supported by the terminal communication software.

SIGNALMAN MARK I MODEM

Anchor Automation, Inc.
$79

PERFORMANCE RATING
Performance: Good
Documentation: Fair
Ease of Use: Good
Usage: Home - Excellent

FEATURES
Interface: RS-232C
Baud Rate: 110 and 300
Direct connect
Cable: Plugs into handset modular plug
Communication Mode: Full duplex
Operating Modes: Manual dial/answer
Dimensions: length 8 in. × width 4 in. × height 1.5 in.
Weight: 1 lb.

The hobbyist who wants to communicate with bulletin boards and database services but doesn't want to spend much for a modem should take a close look at this unit. The Signalman Mark I is an economical, reliable, inexpensive direct-connect modem. The cable plugs into a modular telephone just like the handset does. The handset then plugs into the modem plug so you can monitor telephone dialing and connection. It does not connect directly to the line coming in from the telephone pole. If the telephone dialing mechanism is in the handset, this modem will not work.

The Mark I transmits and receives data at 110 or 300 baud (11 or 30 cps). This speed is compatible with most bulletin boards. At this rate, long-distance telephone bills may add up quickly. If you want to use the modem for much long-distance communication, the Signalman Mark XII, which communicates at 1200 baud, may be more desirable. (See the review of the Signalman Mark XII.)

The plug to the computer is compatible with a serial RS-232C port. The unit does not have fancy features such as auto dial, auto answer, or an audio speaker. However, for $79 one cannot expect such luxuries.

The 3-page manual shows the pin connections to the computer so the user can troubleshoot interfacing problems. The manual is short but clearly written.

To use this modem the user must have a communications program.

SUMMARY

The Signalman Mark I is a reliable, inexpensive direct-connect modem. It does not have any fancy features but will get a hobbyist on-line. The communication rates are 110 and 300 baud, and it connects to an RS-232C serial computer port and modular telephone plug at the point at which a telephone handset plugs in.

SIGNALMAN MARK XII MODEM

Anchor Automation, Inc.
$399

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home - Excellent; Commercial - Good

FEATURES
Interface: RS-232C
Baud Rate: 0 to 1200
Direct connect
Cable: plugs directly to incoming phone line
Communication Mode: Full and half duplex
Operating Modes: Auto answer/auto dial
Rotary and touch-tone dial
Dimensions: length 10 in. × width 6 in. × height 1.5 in.
Weight: 1.3 lbs.

The Mark XII modem works exactly like the Hayes Smartmodem, but costs several hundred dollars less. It uses the same operating commands as the Hayes and performs many of the same functions. (See review of Hayes Smartmodem.) With proper software support, the auto answer/auto dial features allow the user to send and receive telephone messages while absent from the terminal.

The Mark XII is an economical, reliable, relatively inexpensive direct-connect modem. The unit plugs directly into the telephone wire from a telephone pole. It sends and receives data at speeds of up to 1200 baud (up to 120 cps), which is compatible with both bulletin boards and database services. The plug to the computer is RS-232C compatible.

Indicator lights on the front panel inform the user of modem and communication status. The modem automatically adjusts to the baud rate of the computer with which it is communicating. The HS light indicates that the modem is operating at high speed; the CD light indicates whether the carrier from the receiving modem is detected; the SD/RD light indicates that the modem is either sending or receiving data; and the MR light indicates that the modem is receiving power. The on/off switch is located on the front of the unit. The modem does not have a speaker to monitor the phone line.

The 30-page manual has an excellent diagram that shows how to hook the modem into the phone and computer. The user trouble-shooting guide and the diagram that shows the plug pin connections and specifications are well done. The user should have no trouble getting the system installed and configured correctly.

SUMMARY

The Signalman Mark XII is a Hayes look-alike modem that uses the same commands and has many similar features, but costs a couple of hundred dollars less. The Mark XII isn't mounted in as pretty a case as the Hayes, but performs well and is reliable. This modem would be useful to both home and small commercial users.

VOLKSMODEM DIRECT-CONNECT MODEM

Anchor Automation, Inc.
$79.95 without cable; $99.95 with cable

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Good; Hacker - Fair
Ease of Use: Good
Usage: Home - Good

FEATURES
Terminal software required
Compatibility: Bell 103
Data Format: Serial, binary, asynchronous
Operating Modes: Manual dial and answer
Interface: RS-232C serial
Baud Rate: 300
Cables: Computer specific
Communication Mode: Full and half duplex
Power Supply: 9-volt battery
Dimensions: depth 7.5 in. × width 3.5 in. × height 1.5 in.
Weight: 1 lb.

The Volksmodem provides an inexpensive and reliable method for the computer hobbyist to enter the age of telecommunications. When the modem is connected, the user can still use the telephone normally. The modem automatically selects the answer or originate mode. To use the Volksmodem, the user must have software, called communications programs, which are available for only a few dollars through public-domain computer club libraries.

The manual is rather short for novices. It doesn't define baud, parity, and so on; but does tell the user to check them relative to the remote computer (the computer at the other end of the phone line). A good troubleshooting chart indicates solutions to common problems.

Reports from dealers and users suggest that the Volksmodem performs reliably and consistently. As an additional bonus, Anchor Automation often offers a limited membership in The Source database service, with the purchase of a Volksmodem. Check with your dealer for further details.

SUMMARY

For a basic modem that will get a novice into telecommunications, the direct-connect Volksmodem is economical and reliable. It's not fancy, but it gets the job done.

212F2-32 MODEM

ComData Corp.
$337

PERFORMANCE RATING
Performance: Excellent
Documentation: Poor
Ease of Use: Good
Usage: Home/Commercial - Excellent

FEATURES
Baud Rate: Asynchronous, 1200 bits per second
Interface: RS-232C serial
Industry Compatibility: Bell 212A or equivalent
Jack: RJ11C
Communication Mode: Full duplex
Controls: Voice/data selection; Manual answer/originate mode selection
Operating Modes: Manual originate and answer
Indicators: Carrier detect
Power Supply: Wall module
Dimensions: width 8 in. × height 1.73 in. × depth 12 in.
Weight: 2 lbs.

The ComData 212 direct-connect modem works with both a rotary dial and touch-tone telephone system. The modem comes equipped with a grounded transformer-type power supply and a telephone cord. The power supply is hard-wired into the modem, which may make the unit more expensive to repair and awkward to transport. The RS-232C serial cable is sold as an option. The heavy-duty circuit board is mounted to a very sturdy metal baseplate and covered with an attractive, high-impact, plastic cover. The low profile makes a convenient surface on which to place the telephone. The CMOS circuits are reliable, produce little heat, and are well vented.

The documentation consists of one mimeographed sheet, which basically says nothing more than "plug this in and turn the switch on." The manufacturer must assume that the dealer will explain how to set up and use the modem. Quite confusing for the novice. The self-test mode is beneficial, although the documentation doesn't show how to use it or how to troubleshoot problems.

ComData provides no software with the modem, so the user must purchase a separate terminal program.

I tested this modem on a noisy telephone line and it transmitted flawlessly. My only disappointment was that it wouldn't also transfer data at 300 baud. This pretty well limits its market to commercial users.

SUMMARY

The ComData 212 modem works with 1200 baud transmissions only. Dialing and answering are performed manually. The documentation is almost nonexistent, so the user should have the store personnel explain how the modem is to be used. This direct-connect, full-duplex modem is reasonably priced and suitable for many small business needs. It worked flawlessly, even on a noisy telephone line.

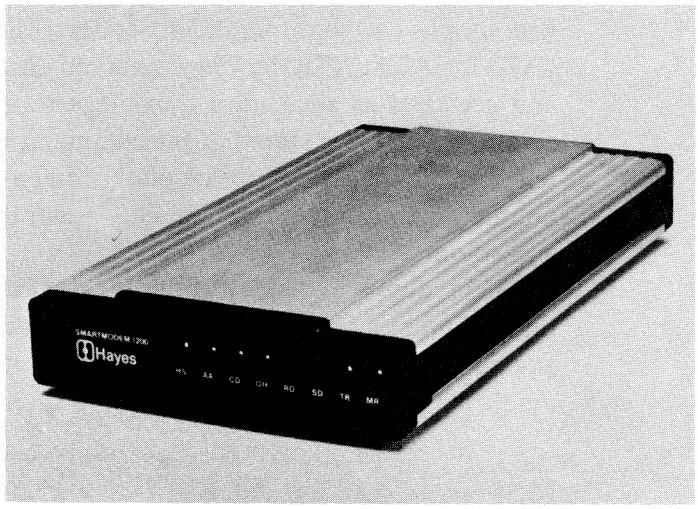
HAYES SMARTMODEM

Hayes Microcomputer Products, Inc.
Model 300: $289; Model 1200: $699

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Excellent
Usage: Home - Excellent; Commercial - Excellent

FEATURES
Interface: RS-232C
Data Transmission Rate: Model 300: 110 or 300 baud
Data Transmission Rate: Model 1200: 300 or 1200 baud
Dialing Capability: touch-tone and rotary-dial pulse
Telephone Connection: modular telephone jack
Compatibility: Bell System 103 or 212A (Model 1200 only)
Communication Mode: Asynchronous/full or half duplex
Modes: Originate/answer/auto answer/auto dial
Command Buffer: Up to 40 characters
Dimensions: height 1.5 in. × width 5.5 in. × depth 9.6 in.
Speaker
Memory: Redial last number dialed
Self-test

The Hayes Smartmodem is the finest modem I've seen. It plugs in and then works perfectly. The Hayes Smartmodem 300 and 1200 are essentially the same machine, except for differences in transmission speed. The Model 300 can send and receive data at 110 or 300 bits per second (10 or 30 cps) and the Model 1200 can send and receive



Hayes Smartmodem 1200. Courtesy of Hayes Microcomputer Products, Inc.

data at 300 or 1200 bits per second (30 or 120 cpi). I reviewed the Model 1200 only; but my findings apply to both models.

Good Hardware Design

The front panel displays eight LEDs that indicate modem status: modem ready, terminal ready, sending data, receiving data, phone connected, carrier detected from another modem, auto answer ready, and 1200 baud mode. Due to space constraint, each light is labeled with a two-letter code. The novice may have a bit of trouble memorizing the codes at first. The back of the unit has a power switch, power plug, RS-232C serial port, telephone connector, and volume control knob.

DIP switches, conveniently located behind the front panel, allow the user to configure the modem to the specific hardware and software used with it. This lets the user turn the modem on and have it ready to go.

The unit will operate in both full-duplex and half-duplex modes. Memory registers allow the user to set the number of answer rings, change those escape codes which should be recognized as commands, and set the length of time to wait for a dial tone.

An audio speaker lets the user hear what the modem is doing, so that the user knows if a line is busy, if a wrong number has been reached, or if a human voice is on the other end of the call. The modem does not allow the operator to talk back using voice.

The documentation gives an excellent description of the installation, telephone company rules, controls, and connectors.

Terminal Software Required

Ease of use depends somewhat on the nature of the terminal or bulletin board software used with the computer. The Smartmodem has simple software command codes. All commands begin with "AT" for ATTENTION. The command characters follow the "AT" and are read as such until a carriage return is pressed. Up to 40 commands may be stored in the command buffer. These commands tell the modem to pick up the phone, dial a number, allow a certain number of rings before disconnect, repeat the last issued command, and so on.

The modem will display either the digit code or English words on the computer's CRT screen to tell the user what is happening; for example, "phone ringing" or "connection made." The transmission

speed (baud rate) is automatically adjusted to that of the receiving modem.

Excellent Documentation Enhances Value

Many examples in the manual inform the user what the error codes mean and what to do about them. There is also a chapter that tells the user how to write programs to operate the modem. Some BASIC language program examples would be an additional asset, but are not included.

The appendices describe the RS-232C serial pin outs, the modular telephone connector, telephone frequencies, circuitry, and technical specifications. An ASCII character table and hex/decimal code table are handy references. One appendix describes how to use the Smartmodem in a local area network (LAN) and as a data line monitor. Instructions also decribe how to link the modem to an amateur radio in order to send RTTY code and handle AFSK signals. A schematic illustrates how to hook the modem to the radio.

A tear-out, quick reference card in the back of the manual lists the commands and error codes in alphabetical order.

Two-Year Warranty

Hayes warranties their modems for two years. They refer the user to the local dealer for warranty and service.

SUMMARY

The Hayes Smartmodem Models 300 and 1200 are about the best on the market. In fact, they are often spoken of as benchmarks. The modem is easy to use and performs all the functions needed for effective telecommunications. DIP switches allow the user to configure the modem to almost any hardware/software system. The modem must be used in conjunction with a terminal program in the computer. Auto dial, auto answer, and monitoring functions make usage simple and effective. Documentation is excellent for the installer and user.

HAYES MICROMODEM 100

Hayes Microcomputer Products, Inc.
$399

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Excellent
Usage: Home - Good; Commercial - Fair

FEATURES
Telephone Connection: Direct-connect
Interface: Direct-connect S-100 bus
Data Transmission Rate: 110 or 300 bits per second
Compatibility: Bell 103 type
Operating Modes: Auto dial, auto answer
Communication Modes: Full duplex and half duplex
Dialing Capability: Touch-tone and rotary dial pulse
Power Supply: Host computer
Warranty: Two years
Communications software required

The Micromodem 100 modem connects directly to a computer S-100 bus to give reliable communications capabilities. With a baud rate of 110 or 300 bits per second (11 or 30 cps), this modem is not suited for business applications that require long-distance telephone data transmissions. See the Hayes Smartmodem review for other features and benefits of this product.

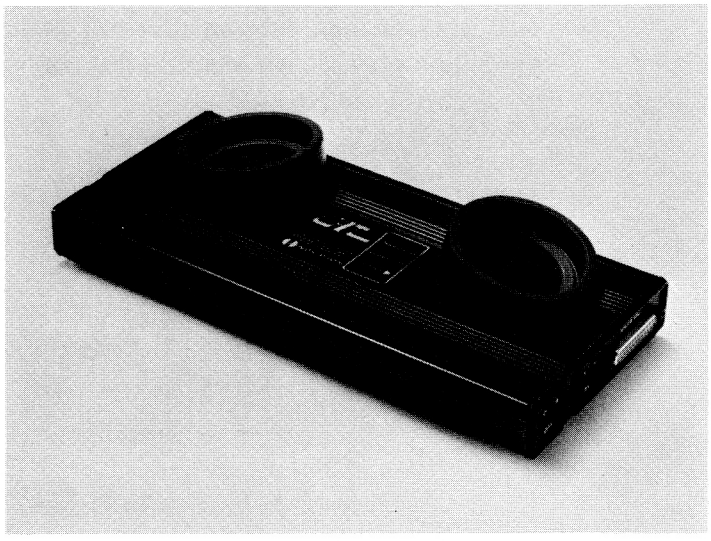
CAT ACOUSTIC MODEM

Novation, Inc.
$189

PERFORMANCE RATING
Performance: Good
Documentation: Excellent
Ease of Use: Good
Usage: Home - Good

FEATURES
Baud rate: 0 to 300 bits per second
Compatibility: Bell 103/113
Interface: RS-232C serial
Communication Modes: Half and full duplex
Operating Modes: Answer, originate, test
Indicators: Power on/carrier ready
Power Supply: Wall-mounted transformer
Dimensions: length 10 in. × width 5 in. × height 2.5 in.
Weight: 1.5 lbs.

The computer hobbyist or business person with occasional telecommunication needs will find the CAT acoustic modem reliable and versatile. The telephone handset fits snugly into the CAT rubber cups. It's compatible with all telephone lines and can even be



The CAT Acoustic Modem. Courtesy of Novation, Inc.

used with a motel or pay telephone if AC power is available. At 300 baud the modem transmits or receives approximately 30 characters per second so long-distance telephone bills add up rapidly. The user manually dials and answers calls. A wall-mount transformer provides power.

The documentation is excellent for both novices and hackers. The bold-face subtitles, schematics, and illustrations are very well done and easy to read.

CCITT CAT ACOUSTIC MODEM

Novation, Inc.
$189

PERFORMANCE RATING
Performance: Good
Documentation: Excellent
Ease of Use: Good
Usage: International Business - Good

FEATURES
Baud rate: 0 to 300 bits per second
Compatibility: V.21 (International communications)
Interface: RS-232C, V.24, V.28
Communication Modes: Half duplex and full duplex
Operating Modes: Answer, originate, test
Indicators: Power on/Carrier ready
Dimensions: length 11 in. × width 5 in. × height 3 in.
Weight: 2 lbs.

The CCITT CAT is designed for users needing international communication capabilities over any type of phone line. The rubber cups self-adjust to fit most telephone handsets. A flexible strap secures the handset to the modem. Even though the maximum transmission rate is 300 baud, I rated it as good. Since foreign telephone systems aren't as good as those in the U.S., the 300 baud transmission rate is more reliable.

Documentation is excellent for both novices and hackers. The bold-face subtitles, schematics, and illustrations are very well done and easy to read.

SUPER MIKE

Novation, Inc.
$15

PERFORMANCE RATING
Performance: Good
Documentation: Excellent
Ease of Use: Excellent
Usage: Home/Business - Excellent

FEATURES
Handset Compatibility: Western Electric 500 compatible
Harmonics: Distortion 40 dB below signal level

SUPER MIKE is an FCC-approved condenser microphone that replaces the old carbon one in telephone handsets. The solid-state integrated circuit preamplifier improves signal-to-noise ratio in all acoustic-type communications. SUPER MIKE transmits pure, clear data up to five times more efficiently through any acoustic coupler. It's as easy to install as unscrewing the handset mouth piece and screwing SUPER MIKE in its place. SUPER MIKE may be removed or reinstalled as often as desired.

D-CAT DIRECT-CONNECT MODEM

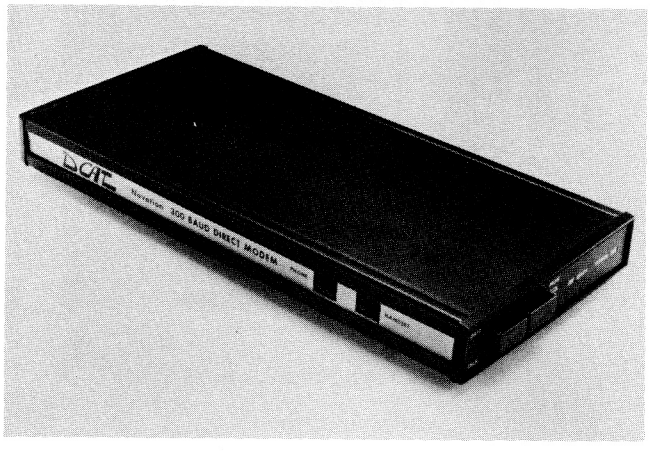
Novation, Inc.
$199

PERFORMANCE RATING
Performance: Good
Documentation: Excellent
Ease of Use: Good
Usage: Home - Good

FEATURES
Baud Rate: 0 to 300 bits per second
Compatibility: Bell 103/113
Communication Modes: Half duplex and full duplex
Operating Modes: Talk, monitor, normal, test
Indicators: Power on/carrier ready
Dimensions: length 10 in. × width 4.7 in. × height 1.2 in.
Weight: 12 ounces

The D-CAT direct-connect modem plugs into the jack that the telephone handset uses. Wall and Princess-style phones with the dialing mechanism in the handset will not work with D-CAT. D-CAT may be used with either single or multiline telephones without the need for adapters, and is compatible with the 103 or 113 Bell modem. The case design permits the telephone to sit on top of the modem to conserve desk space. A mode switch allows the user to monitor whether voice or data is being received.

Documentation is excellent for both novices and hackers. The bold-face subtitles, schematics, and illustrations are very well done and easy to read.



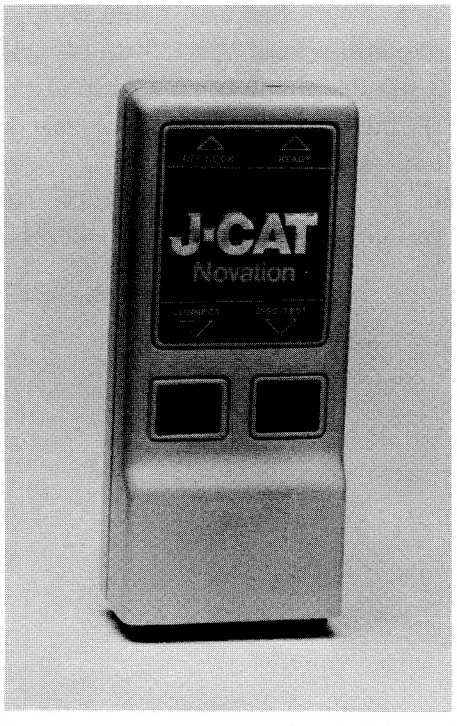
The D-CAT Modem.
Courtesy of Novation, Inc.

J-CAT ORIGINATE/AUTO ANSWER MODEM

Novation, Inc.
$149

PERFORMANCE RATING
Performance: Good
Documentation: Excellent
Ease of Use: Good
Usage: Home - Good

FEATURES
Baud Rate: 0 to 300 bits per second
Compatibility: Bell 103/113
Interface: Serial I/O; RS-232C
Data Format: Serial, binary, asynchronous
Communication Mode: Full duplex
Operating Modes: Auto originate, auto answer, manual originate, manual answer, self-test
Controls: Auto/manual, connect, disconnect/test
Indicators: Off-hook, carrier ready, audio beeper
Carrier Detect: On delay 150 msec; Off delay 50 msec.
Dimensions: length 5 in. × width 2 in. × height 1.3 in.



The J-CAT Modem. Courtesy of Novation, Inc.

J-CAT is one-fifth the size of ordinary modems so it can be mounted on the side of a computer, phone, or CRT. It automatically answers calls and adjusts to the proper baud rate. An audio indicator informs the user of line status. J-CAT also notifies the user whether the dialtone is available and whether the dialed party's line is busy. This modem has most of the features that a home user desires. At 300 baud it can perform both home and business communication functions; however, long-distance phone bills could pose a problem.

The documentation is excellent for both novices and hackers. The bold-face subtitles, schematics, and illustrations are very well done and easy to read.

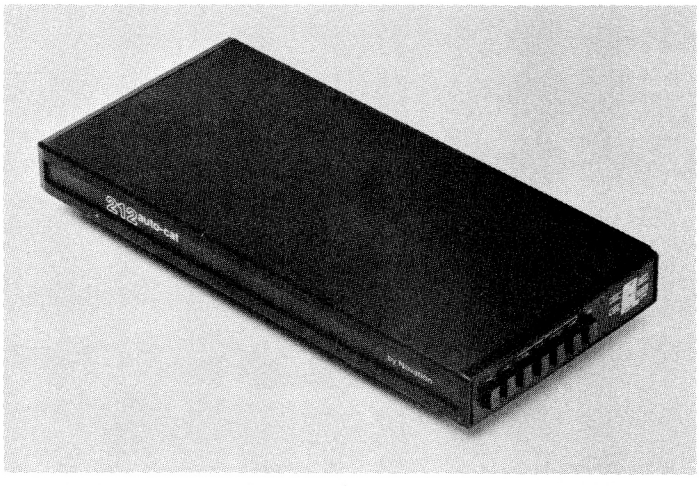
212 AUTO-CAT DIRECT-CONNECT MODEM

Novation, Inc.
$695

PERFORMANCE RATING
Performance: Good
Documentation: Excellent
Ease of Use: Good
Usage: Home - Excellent; Business - Good

FEATURES
Baud Rate: Low-speed mode - 0 to 300 bits per second; High-speed mode - 1200 bps asynchronous; 1200 bps synchronous
Compatibility: Low-speed - Bell 103/113
High-speed - Bell 212A
Interface: RS-232C with pulse dial
Data Format: Low speed - Serial, binary, asynchronous
High-speed - serial, binary, character-asynchronous/bit-synchronous
Communication Mode: Full duplex at all data rates
Operating Modes: Auto answer, auto disconnect, manual answer, manual originate, manual disconnect
Front Panel Indicators: Transmit, receive, ready, answer, 1200, off-hook, test check
Dimensions: length 10 in. × width 4.7 in. × height 1.2 in.
Weight: 1.5 lbs.

This 300/1200 baud, full-duplex modem plugs into a modular phone jack. It's well suited for business and excellent for home use.



The 212 AUTO-CAT Modem. Courtesy of Novation, Inc.

Since it can send and receive at both 300 and 1200 baud, computer users can dial computer club bulletin boards, connect to network services, and make long-distance transmissions at economical phone rates. In the originate mode, the data rate can be set manually or by a computer or terminal through the RS-232C port. In receive mode, the modem automatically answers incoming calls and selects the appropriate transmission speed. If desired, the user can set switches to keep the modem from answering incoming calls in order to keep the telephone line open. The modem may also ring without answering. A pulse-dial interface allows implementation of an auto dialing program under computer control. A seven-segment display lets the user know the exact operating mode.

Documentation is excellent for both novices and hackers. The bold-face subtitles, schematics, and illustrations are very well done and easy to read.

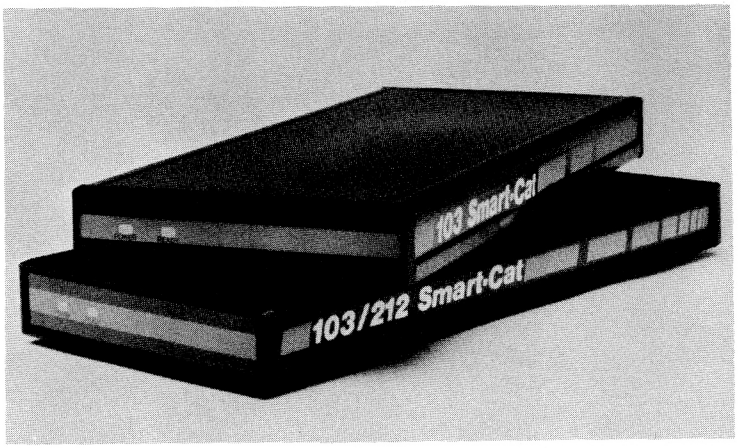
SMART-CAT 103 AND 103/212

Novation, Inc.
103: $249; 103/212: $595

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Excellent
Usage: 103: Home - Excellent; 103/212: Home - Excellent; Business - Excellent

FEATURES
Baud Rate: 103 - 110, 300 bits per second (bps)
103/212 - Low speed - 300 bps
High speed - 1200 bps asynchronous
Compatibility: Low Speed - Bell 103/113
High speed - Bell 212A
Interface: RS-232C serial
Data format: Serial, binary, asynchronous
Communication Mode: Full duplex at all data rates
9 automatic response codes, 5 status information response codes, 6 option switches, 32-character DIAL command buffer, 2 LED indicators, (power/carrier ready)
Operating Modes: Auto answer, auto dial, (touch-tone/pulse), auto disconnect, manual answer, manual originate, manual disconnect
Commands: 21 serial input commands
Dimensions: length 10 in. × width 4.7 in. × height 1.2 in.
Weight: 103 - 1.1 lbs.; 103/212 - 1.25 lbs.

The two SMART-CAT direct-connect modems offer an extensive software command set, a built-in dialer for touch-tone or rotary service, auto answer, busy detector, and automatic redial. As an unattended modem the SMART-CAT will also automatically answer



The SMART-CAT Modem. Courtesy of Novation, Inc.

calls. The user can program the modem to answer after a certain number of rings and to give specific responses pertaining to the connection. Some of the commands used are ANSWER, BREAK, COUNT, DIAL, ECHO, FORMAT, GIVEBACK, HANGUP, INITIALIZE, LONG, MODEM, NEW, ORIGINATE, PICKUP, QUERY, REDIAL, SPEED, TEST, UNLISTEN, VOICE, and XMIT. The Model 103 is excellent for home use, and the 103/212 would fit both home and business use. The "intelligence" of these modems makes telecommunications a pleasure.

Documentation is excellent for both novices and hackers. The bold-face subtitles, schematics, and illustrations are very well done and easy to read.

RACAL-VADIC VA3451 MODEM

Racal-Vadic
$875

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Good
Usage: Home/Commercial - Good

FEATURES
Direct connect
Operating Mode: Auto dial, auto answer
Dial or touch-tone compatible
Interface: RS-232C serial
Baud Rate: 300/1200 automatic
Communication Mode: Full and half duplex
Indicators: LEDs for transmit, receive, baud rate, clear to send, data set ready, data terminal ready, ring, and carrier detect
Dimensions: length 12 in. × width 7 in. × height 2.5 in.
Weight: 2 lbs.

The Racal-Vadic direct-connect modem provides 300 and 1200 baud data rates that satisfy both home and commercial use. Special commands allow the user to save a directory of telephone numbers for automatic dialing. This is a very handy feature; however, the modem occasionally "forgets" the list. The modem will continue to redial a number until a successful connection is made.

Racal-Vadic offers a one-year warranty on the unit. The documentation is primarily written for the "dumb" modem. An addendum to the manual explains the VA3451 "smart" features such as the auto dial and phone-number list. When the company upgraded the modem, they didn't upgrade the manual.

The modem is easy to use since the functions are activated through software control, instead of mechanical switching. The phone-list memory is handy; however, any editing requires reentering the entire phone-list file. To overcome this problem, I maintain the list in a text file on a computer disk and edit that file as phone numbers change. Should the modem lose its memory from a power interruption, I can download this file into the modem.

SUMMARY

The Racal-Vadic is a good, easy to use, commercial-quality modem. Documentation is not as good as it should be for a modem in this price range. The phone-list memory capability makes auto dialing convenient and efficient.

TELEPORT 300 DIRECT-CONNECT INTELLIGENT MODEM

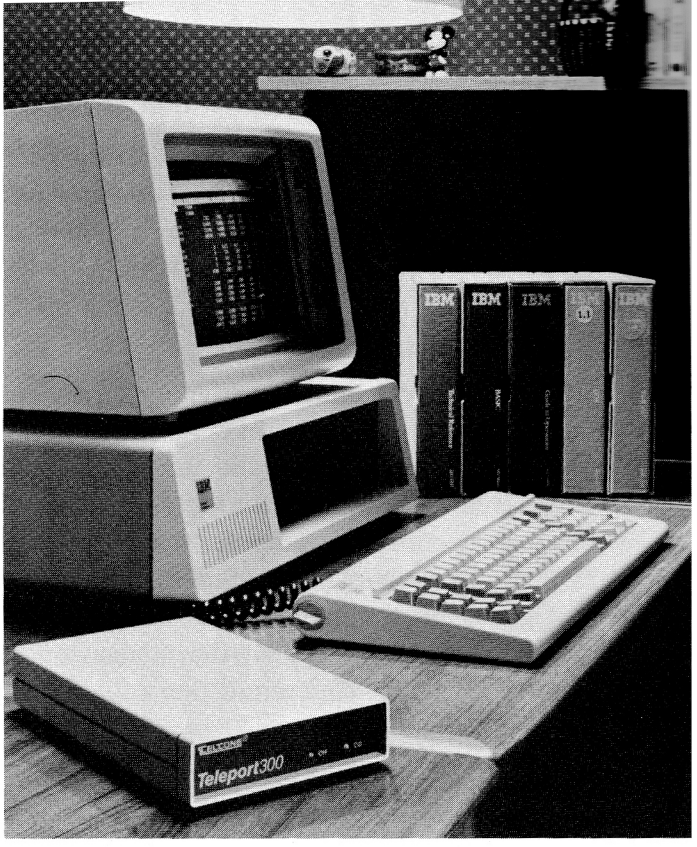
Teltone Corp.
$399.95

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Fair; Hacker - Excellent
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home - Good; Commercial - Good

FEATURES
Auto answer and originate
Automatic selection touch-tone or pulse dialing
Internal real-time clock
Indicators: Connected to phone line; Carrier detect
Interface: RS-232C serial (75 to 9600 baud)
Data Signaling: 300 baud
Compatibility: Bell 103J data set
Test mode
Memory: 8K ROM (built-in modem program); 2K RAM (1024 character buffer)
Menu driven ASCII control and status; automatic disconnect
Terse mode (eliminates menu when no longer needed)
Repertory auto dialing (dials stored numbers); Dialing retry
Automatic tracing of call status (dial, busy, ring tones)
Automatic adjustment to computer/terminal baud rate
Automatic log-on with protected password
Remote touch-tone data entry (password protected)

The Teleport 300 has its own microcomputer and modem firmware (a communications program stored in ROM). The uniqueness of this modem lies in its built-in modem program and in its ability to accept and process touch-tone signals for data input (DTMF). When the computer is connected to the modem through an RS-232C serial port, the modem displays its own menu on the computer screen. The six choices allow the user to originate a call, answer a call, diagnose problems, and access help screens.

The DTMF mode allows the user to control the computer from a remote location with telephone touch tones. In the auto answer mode, the modem accepts the connection and verifies the caller's password. Once the caller is logged on, the caller may enter touch tones, which are converted by the modem into ASCII code that the



Teltone Teleport 300 Intelligent Modem. Courtesy of Teltone Corp.

computer understands. In effect, the computer can be remotely controlled from a standard touch-tone telephone.

The software and internal real-time clock allow the user to have the modem place a call and transmit data during his or her absence. The user can set the number of rings, have the modem automatically redial, set the time between redial times, and set the length of time it should wait for a dial tone. The modem can be set to shut down within a certain time after carrier disconnect. The user can enter a string of commands into the computer to control operation sequences.

The manual has good troubleshooting procedures and a toll-free service number. The block circuit diagrams show port connections. A conversion chart shows how ASCII codes can be changed to touch-tone codes. The manual is clearly written and very friendly to the expert. The fancier procedures are a bit complicated and may confuse the novice. Some error codes are not fully explained and need more examples.

By all appearances, the user must use the internal modem program supplied by the Teleport 300. If the user tries to use a commu-

nications program stored within the computer, there may be some confusion with the modem command codes. The modem should have a procedure for bypassing its internal modem program.

SUMMARY

The Teleport 300 is a 300-baud direct-connect modem with its own modem program stored in ROM. The modem software is menu-driven and very friendly; however, we couldn't find a way to bypass the software in favor of a computer-installed terminal program. Many automatic features make this modem very versatile and easy to use. In addition to the traditional modem features, the user can operate the computer from a remote location by using touch-tone codes that the modem translates into ASCII. Documentation is good, but the explanations of error code could be improved. The only drawback is that the modem operates at only 300 baud, so long-distance communication could be expensive.

Chapter 4

The Expanding World of Mass Storage

Data and software may be stored temporarily within the computer in random-access memory (RAM), or may be stored permanently within the computer in read-only memory (ROM): nonalterable/permanent storage. However, only limited amounts of information can be stored in these expensive, on-board chips. To allow greater storage capacity and access to a multitude of operations, mass storage or long-term storage is made available to the personal computer by means of floppy disks, hard disks, cassette tapes, videodisks, and cache (RAM) disks. Applications, utility programs, and large amounts of data can be stored cheaply on these media until the computer processor needs them.

The type of mass storage that best complements your personal computer application depends on your requirements. Retrieval speed, storage capacity, and convenience of use vary considerably from one storage medium to another.

Years ago personal computers were sold as separate pieces: CPU, monitor, keyboard, tape drive, and disk drives. However, due to tricky compatibility problems, manufacturers have found that they can sell, service, and support integrated packages much more effectively. That's why most computer systems come in a box complete with monitor and disk drives—Kaypro, Columbia, Radio Shack, Apple Macintosh, IBM PC Portable, IBM PCjr, and Sony SMC-70

are some examples. The average buyer doesn't buy one brand of computer and another brand of mass storage.

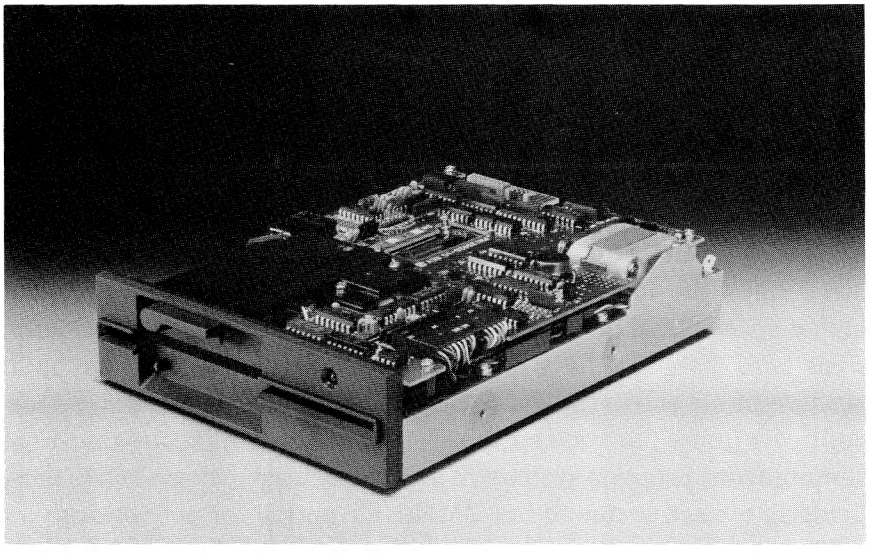
A few third-party manufacturers provide less expensive mass-storage peripherals for popular computers. For example, Rana and Percom make inexpensive drives for Apple and Atari computers. Saving several hundred dollars can be an attractive incentive for buying a third-party disk drive. The drives are specifically designed for these computers, and often come with a disk-based operating system, which must be used instead of that provided by the computer manufacturer. Of course, hackers will continue to buy stripped-down drives through mail order catalogues for a fraction of what ordinary mortals pay. But they don't need to read this book anyway.

For all practical purposes, today's computer owners are buying mass-storage devices customized for their computer by the manufacturer. Those in the market for hard disk drives will probably consult with a supplier as to what equipment is designed for their computers. Few will buy a $2000 to $10,000 package without some expert advice and product support.

This chapter is primarily designed to acquaint you with the kinds of decisions you may have to make in selecting the mass storage system which will probably come with your computer. This may affect the decision you make about buying the computer itself. Major, respected disk drive manufacturers include Corvus, Qume, Shugart, Tandon, NEC, Percom, and Rana. Most computer manufacturers contract with these companies to make custom drives for their computers.

The cassette tape recorder/player resembles the device used to play music. Some computers such as the Atari and Commodore require special circuits to interface (connect) with tape units. The data and programs are stored on magnetic tape in sequential fashion (item after item). Since audio cassette tape drives are inexpensive and are not designed or manufactured with precision, they are not especially speedy or accurate. Specially designed drives, such as the Commodore's, perform very well if the heads are properly cleaned and the tapes are not worn out. Cassette tape is generally used to store game programs or to back up other storage media for safe keeping.

Another medium, the stringy floppy tape, operates at very high speed. At this time, the only major personal computer using this



YD-380T Floppy Disk Drive. Courtesy of C. Itoh Electronics, Inc.

technique is the Coleco Adam. This special endless-loop tape (formatted by the factory) can move very rapidly through the mechanism for data search procedures. The tapes cost approximately $10 each and may eventually wear out and slip. Stringy floppies approximate the same access speed as the slower floppy disks, but the tape drive costs much less.

Streaming tape drives are used to back up hard disks. They are high speed, compact, and made with great precision. For example, Tallgrass provides a built-in streaming tape with its hard disk. Since these tape drives may cost as much as $1000, hard disk drive buyers should investigate the cost of back-up devices in conjunction with shopping for the hard disk itself. Corvus uses a standard video tape recorder for a back-up system; in addition, however, the user must purchase the $300 Tape Mirror interface system.

Since many computer applications require rapid location of specific information, sequential data storage has been abandoned for the faster direct-access magnetic disk. Data is stored on concentric circles located on the disk surface. The disk drive unit spins the magnetically coated Mylar disk housed within a protective cardboard or plastic jacket. The read/write head (similar to that on a tape recorder) moves in and out from the edge to the center of the disk to locate the track on which the data is stored. As the disk spins at 300 rpm, the head riding on the disk surface senses the recorded data. Information may be accessed (read) from a disk or saved

(written) to a disk in a fraction of a second, depending on how far the head must move. Direct access is more efficient than sequential access and is the preferred method of mass storage for most applications.

Business applications often demand even faster access speed and the ability to store and sort large volumes of data. The hard disk drive spins the magnetically coated metal or glass disk at much higher speeds than the flexible floppy disk. For faster track location, some hard disks also have multiple read/write heads that float on a cushion of air above the disk. A hard disk is almost mandatory for multiuser (more than one terminal) and multitasking (more than one simultaneous process) systems. The Corvus hard disk system is particularly attractive due to the OMNINET option for networking.

The newest technology for mass storage is the videodisk. A laser "burns" (ablates) the digital code into the disk, and the information is later read or sensed by a photodiode. Spinning at high speeds the laser disk works as fast as the hard disk. Since the laser can sense or detect very tiny spots that represent data, the disk is capable of holding up to 5000 times as much information as a floppy disk—amounting to 4 gigabytes (four billion characters). At present, laser disks cannot be erased or reused, but their enormous storage capacity and low price make them attractive. Laser disks will become more popular during the 1980s, especially for presenting video-quality graphics for computer games. The SONY SMC-70 and many other computers are already designed to interface with laser disk equipment.

Cache disks are not really disks at all, but packages of RAM (random-access memory) chips connected to the computer in such a way that the processor "thinks" that they are disk drives. Since RAM is accessed almost instantaneously, cache disks can speed up operations considerably. Depending on how it is constructed, the information in the cache disk may be erased when the power is turned off. Therefore, for long-term storage, it's necessary to "dump" the cache disk data onto magnetic media. Some computer cache disks are made of bubble memory, which isn't as fast as chip technology but is frequently less expensive. Bubble memory is nonvolatile; that is, information is retained for a long time even after the power is removed. This is particularly valuable for portable computers such as the Grid. A cache disk is best for applications requiring large programs; for example, a sophisticated word processor

with a spelling checker may reside in the cache disk, enabling instructions to be rapidly called forth as the processor requires.

The first question you should ask is, "How do I plan to use mass storage?" The following checklist may help in answering this question. When evaluating its features, you might rate each feature as essential (+++), desirable (++), and nice but can do without (+). In this way, making compromises in the final choice can be easier.

1. How much can I afford to pay?_____
2. What computer am I going to connect it to?_____
3. Does my computer have a serial/parallel port?_____
4. Does my computer have add-on storage capabilities?_____
5. What software will operate with the mass-storage device?_____
6. What physical size/weight should it be?_____
7. Should the mass-storage device be portable?_____
8. How fast must I retrieve/save information?_____
9. How accurately must data be retrieved/saved?_____
10. Do I need to retrieve/save information in sequential/random form?

    _____
11. How much information will I retrieve/save?_____
12. How often will I retrieve/save information?_____
13. Do I need to sort (alphabetize/order) large amounts of data?_____
14. How many computers will access mass storage?_____
15. How many tasks (programs) must the system perform simultaneously?_____
16. What is the cost of the storage medium (tape/floppies)?_____
17. What provision is there for back-up?_____
18. Is the storage medium reusable?_____
19. What is the short-term/long-term maintenance?_____
20. What warranty do I want?_____
21. What type of service do I need?_____

This chapter will help you find a mass-storage method that best meets the needs identified. I chose not to review specific mass-storage devices since each product is usually very computer-specific

6, 12, and 18 Megabyte Winchester (Hard) Disk Drives from Corvus. Courtesy of Corvus Systems, Inc.

age devices since each product is usually very computer-specific and will only work with limited applications. However, the following generic discussions and examples should help you to pick out the mass-storage device most appropriate for your computer and application.

How Much Can I Afford to Pay?

As a rule, cassette tape storage systems are the least expensive mass-storage devices. Cassette recorder/players range in price from $20 to $100 and are generally used with game computers. Some recorder/players have interfaces or other electronic circuits that make them compatible with specific computers, for example, the Atari and Commodore. Other computers may use a recorder/player originally designed to play music. Reportedly, Panasonics work well. Sony recorders tend to be too volume-sensitive, and Realistic recorders have a poor performance history. The Commodore Datasette digital recorder is reliable and reasonably priced. Make sure the recorder/player you select is compatible with your computer. You may have to purchase a special interface in order to use a standard audio machine.

Tape systems are frequently used to back up floppy disk and hard disk systems. The information stored and utilized on the disks is transferred or copied onto tape for safe keeping. This guards against natural catastrophe and gross human error.

Floppy disk drives range in price from $250 to $1000, depending on quality and other features. Hard disk systems range from $1000 on up, depending on capacity and speed. Videodisk systems will be competitively priced with floppy disk drives. Cache disks vary in price according to size and the computer for which they are designed.

What Computer Am I Going to Connect It To?

Many computer systems have built-in mass storage devices. For example, Radio Shack computers have floppy disk drives built into the console; the Sony Typecorder has an on-board cassette tape; and the Kaypro 10 has a built-in hard disk. Many computer configurations have ports (plugs) that allow you to install external (peripheral) mass-storage devices. Computers with on-board mass storage may allow you to add external storage devices. Make sure that the computer you buy is equipped to interface with and operate the particular mass-storage device you want.

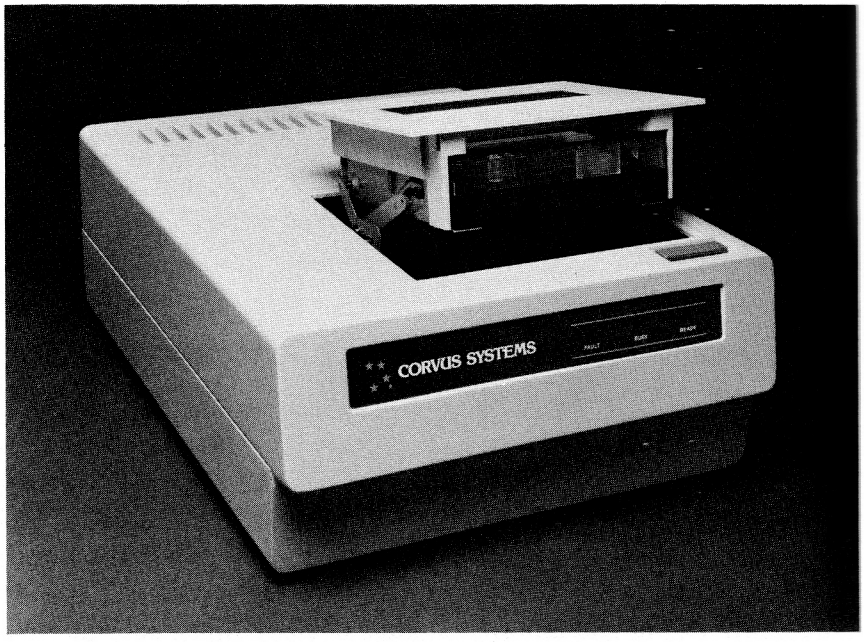
Does My Computer Have a Serial/Parallel Port?

Most peripheral mass-storage units connect to the computer through a parallel port. In this way information is transferred in a byte by byte fashion. Each character or symbol consists of eight bits of data (binary 1s and 0s). Eight bits translate roughly into one byte or character. In parallel communication, the bits travel simultaneously through eight wires to and from the mass storage device. In serial transmission, the bits travel in single file through one wire. Atari and Commodore use serial disk interfaces.

Faster parallel drives may be available from third-party manufacturers. Parallel communication is faster; however, data cannot travel long distances without special equipment—25 feet is a practical limit. If your computer doesn't have a port that will interface with peripheral mass-storage devices, don't plan on adding them.

Does My Computer Have Add-on Storage Capabilities?

Not only does the computer have to have ports for connecting peripheral storage devices, it must be capable of utilizing these additional devices. For example, the computer's circuits, programs, and



The Corvus Bank. Courtesy of Corvus Systems, Inc.

operating system must be capable of managing the storage device. Thus, if the disk operating system (DOS) will only address a single-sided disk drive, the computer may not know how to communicate with an external drive. Some computers such as the IBM PCjr may be expanded without modifying the basic computer operating system. Adding storage devices is not like plugging a turntable into a stereo system. Check with the manufacturer's specifications and with the dealer before buying.

What Software Will Operate with the Mass-Storage Device?

The personal computer must have instructions in RAM or ROM which tell it how to put information into mass storage and how to retrieve it from mass storage. The detailed steps taken by the operating system are almost invisible to the user. For example, the disk operating system knows how to copy disks, load files, save files, erase files, and so on. Some "intelligent" drives such as the Commodore's have the instructions stored in ROM within the drive itself. Multiuser operating systems need controllers that prevent users from simultaneously altering a file and gaining access to someone else's confidential files. The software must support the mass-

storage peripheral. Check with the dealer for available options through OEM software and third-party software.

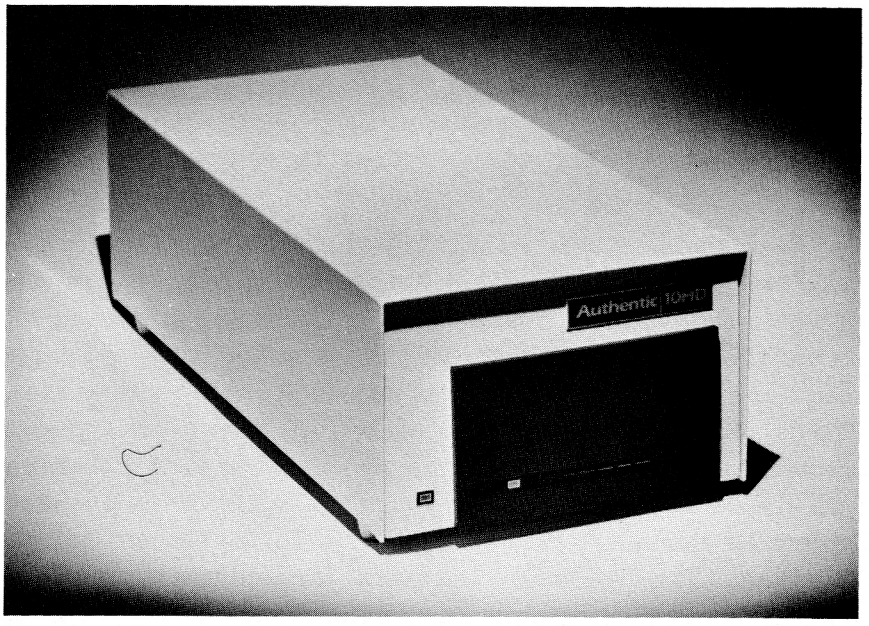
What Physical Size/Weight Should It Be?

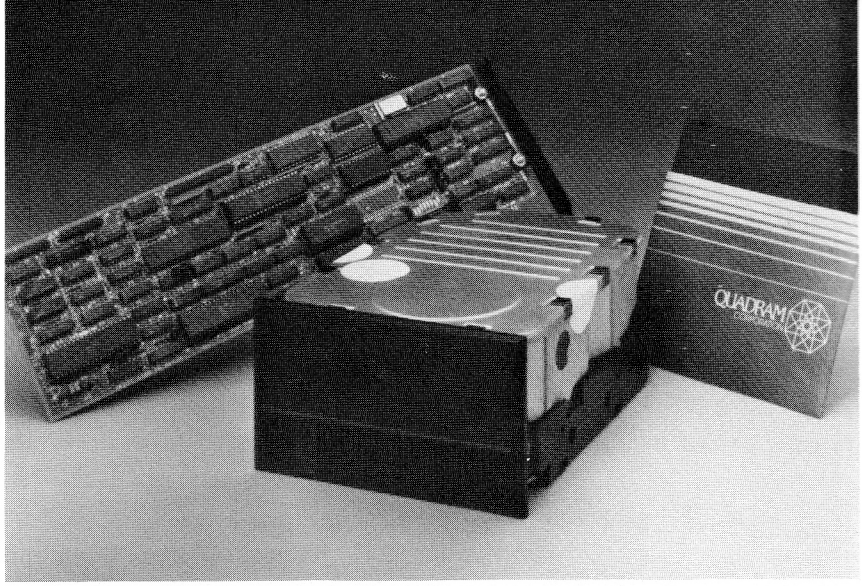
Cassette tape recorder/players are small and easy to carry. Disk drives vary from light to heavy. The lighter-weight drives may not be as durably constructed as the heavier ones. Floppy disk size ranges from 3 to 8 inches so the small disk requires a smaller and lighter disk drive unit. Some hard disk drives are small enough to fit into a portable computer and others fill cabinets the size of a 2 to 3 drawer filing cabinet. You must consider both your application and computer housing facilities when selecting a mass-storage device.

Should the Mass-Storage Device Be Portable?

Size and weight have some bearing on portability. However, mechanical design must also be considered. Cache disks are compact and durable. Although any desktop computer may be picked up and carried to another location without damage, you may wish to insert

The 10HD Hard Disk Drive. Courtesy of NEC Home Electronics (U.S.A.), Inc.





The QuadDisk. Courtesy of Quadram Corp.

a special cardboard protector or a discarded floppy disk into the disk drive to protect the heads from banging about. The portable computer with a hard disk may have a special procedure for locking the head in place during transport; for example, the Kaypro 10 requires that you type "SAFETY" before turning the computer and the hard disk off.

In general, portable computers are specially built for portability. The cases are stronger, and internal struts keep the circuits and components from bending and twisting. Cassette tape recorder/players are portable. Hard disks should probably not be moved unless it's absolutely necessary.

How Fast Must I Retrieve/Save Information?

Speed of data transfer is governed by several factors. The speed at which recording media passes by the read/write heads determines how frequently the media location is available for sensing or recording. Moreover, the density of the information stored on the media affects how much information is stored within a given area. The data transfer rate is also affected by the rate at which it passes through the interface and wires to and from the computer. Even how the data is coded on the media affects rates of retrieval and saving; for example, the Apple and Atari coding systems require that the data be written or read twice. In multiuser systems, the number of users accessing the disk influences response times; for

example, one user may have to wait for another to finish before he can proceed with his own disk transaction.

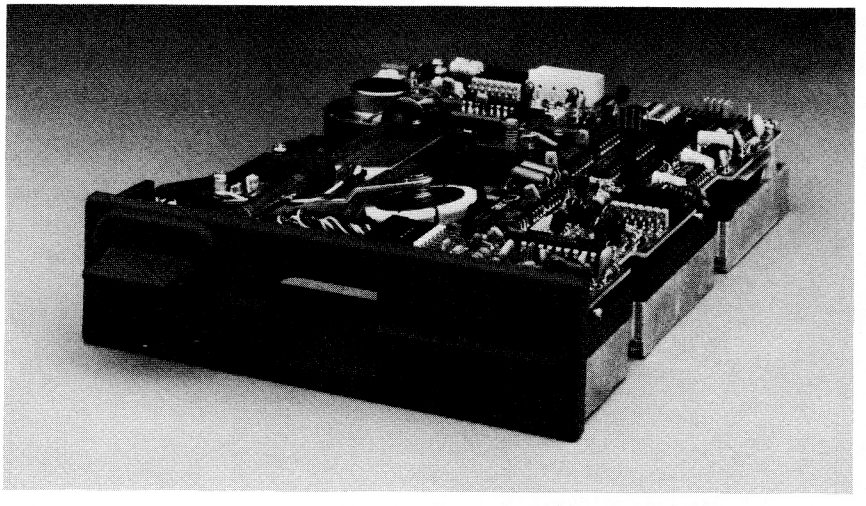
Stringy floppies, used by the Coleco Adam, move the tape rapidly from reel to reel and bring operation speeds up to that of the slower disk drives. However, most of the recorder/players used with game machines require up to several minutes to load or store a lengthy program. In contrast, a slow floppy disk may require ten to twenty seconds; a fast floppy disk a few seconds; and a hard disk a fraction of a second. From the user's viewpoint, hard disks and videodisks operate almost instantaneously.

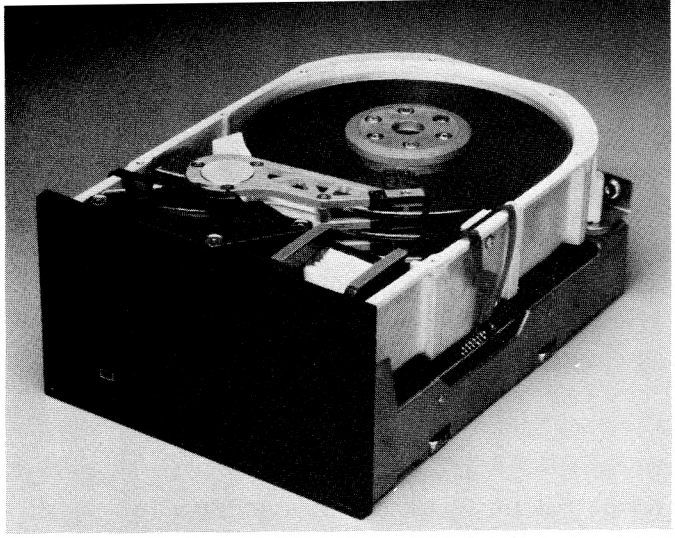
Another scheme uses a cache disk for temporary mass storage. In this arrangement the computer has a large area of random access memory (RAM) attached in the same manner as a floppy disk. The computer "thinks" it has another disk drive, but the cache disk (RAM) acts almost instantaneously to retrieve and store data. Systems such as the Grid and Sony SMC-70, which use large programs or require frequent disk access, can benefit from the increased speed gained through use of cache disks. Information stored on most cache disks will be lost when the computer is turned off.

How Accurately Must Data Be Retrieved/Saved?

Cassette tapes are not known for their high reliability; that is, errors may occur both when data is retrieved and when it is saved

The QumeTrak 142 Half-Height 5.25-Inch Floppy Disk Drive. Courtesy of Qume Corp.

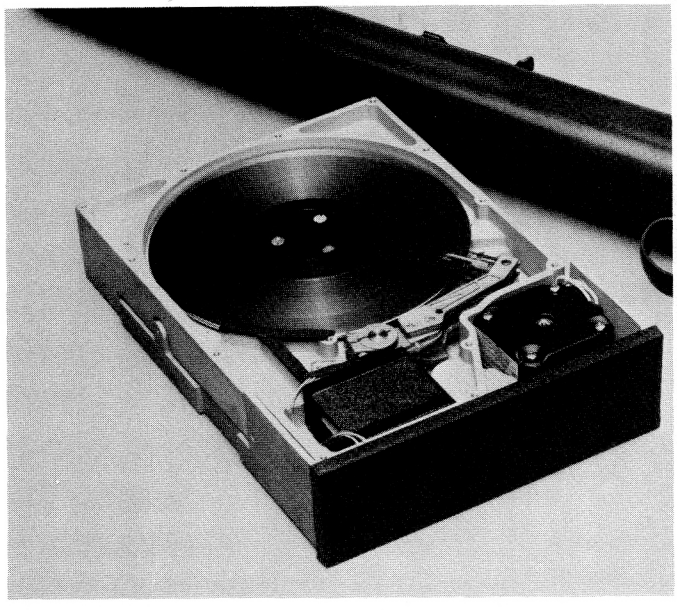




Model TM705 Winchester Hard Disk Drive. Courtesy of Tandon Corp.

(read/write error). Reliability varies from one brand of drive to another. Tape unreliability is partly due to imprecise design and is not inherent in the tape medium. The degree of cleanliness of the tape heads affects reliability more than almost any other factor. As disk drive prices decline, many hobbyists are converting to disk—for both reliability and speed.

The frequency of read/write errors for floppy and hard disks is low. Since the read/write head on most floppy disk drives actually rests on the recording surface of the disk, the opportunity for wear and tear is higher than with hard disk read/write heads, which float on a layer of air above the disk surface. However, with either method, a power failure, a physical jolt, or a speck of dirt may cause damage to the disk and subsequent loss of information. Keeping data back-ups is the best insurance against data distortion or loss.



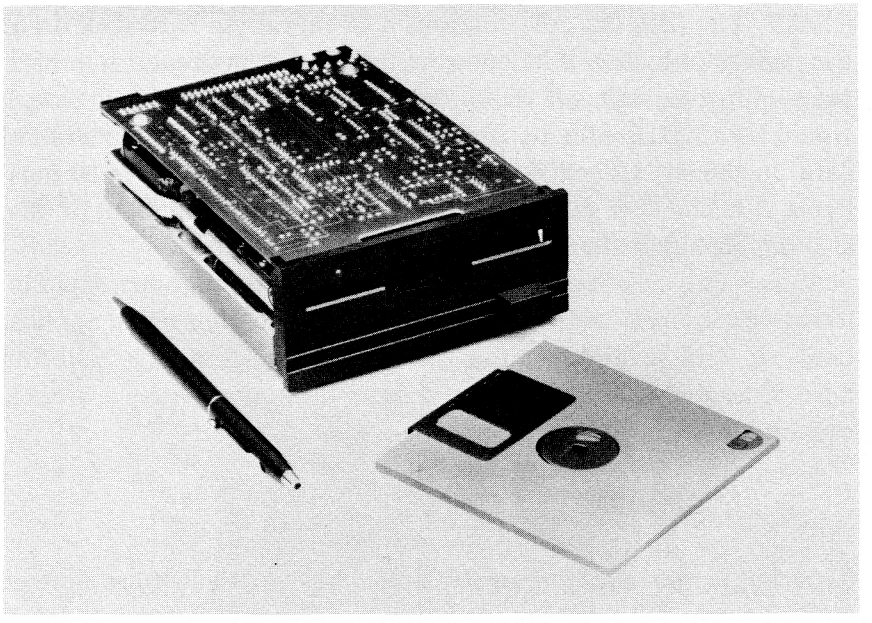
Model TM250 Winchester Hard Disk Drive. Courtesy of Tandon Corp.

Do I Need to Retrieve/Save Information in Sequential/Random Form?

Tapes record information in a sequential form. For example, you listen to music sequentially—note after note. Some accounting or statistical records are used sequentially (i.e., from the oldest check entry to the newest). However, finding a particular check entry requires the computer to locate a specific piece of data buried in a mass of information. Direct access (sometimes misnamed random access) by tape is very difficult and time consuming with inexpensive audio drives. The tape may have to fast-forward or fast-backward past a great deal of data before locating the proper segment of tape.

Floppy disks, hard disks, and videodisks use a storage technique that enables rapid retrieval of a specific piece of data. Through a complex coding system, which is taken care of automatically by the disk operating system (DOS), the computer moves the read/write head to the proper track (concentric circle of recorded information) and waits until the medium rotates to the position where the information is stored. At that point, the data are either stored or re-

Model TM35 Microfloppy Disk Drive. Courtesy of Tandon Corp.



trieved. Direct access is very fast. Since hard disks may use multiple heads and since the media rotate much faster than floppies do, hard disks perform this operation almost instantly. The same is true of videodisks, which rotate from 600 to 1800 rpm. Hard disk systems may best serve applications that require immediate mode interaction; for example, using a personal computer as a point of sale cash register that automatically updates inventory levels.

How Much Information Will I Retrieve/Save?

The capacity of the storage medium varies with both physical size and data density. Tape can retain very large amounts of data and therefore is often used to back up hard disks. Floppy disks store from 80K (80,000 bytes or characters) to about 400K per side. Double-density disks store more information per area of disk than do single-density disks. Some drives are double-sided and thus allow the user to access twice as much area with one disk drive. A personal computer with two double-density double-sided disks may be able to search 1 megabyte (1,000,000 bytes or characters) of information with fairly good speed.

Reasonably priced personal computer hard disks range from 5 to 20 megabytes. Ten megabytes seems to be one size standard since it's the size packaged with the Kaypro 10, Compaq Plus, and IBM PC/XT. The IBM PC AT contains a 20-megabyte hard disk drive. Videodisks (which will be entering the market in greater numbers) store up to 2 gigabytes (2 billion bytes or characters) on each side. It would take 5000 double-density floppy disks to store that amount of data. In theory, videodisk digital data storage capacity is 20 gigabytes. A cache disk generally stores about the same amount of data as a double-sided, double-density floppy disk.

A user with a large number of frequently used programs, rapid interactive requirements, large files of data, large file-sorting applications, or with several terminals that access mass storage will find hard disks and videodisks to be far superior in convenience, storage capacity, and speed.

How Often Will I Retrieve/Save Information?

Some applications require infrequent access to data in mass storage. Once the program and data are loaded from mass storage into inter-

nal memory (RAM), you may not need the mass-storage device again until the operation(s) is complete. For example, word processing input generally requires little disk access.

Some applications, such as real-time information retrieval, require frequent access to mass storage. For example, using the personal computer to make and confirm reservations will require frequent access to storage.

Since the speed of mass-storage access depends on many factors (media, density, coding techniques, speed of media moving past the read/write head, size of file, and operating system), the best way to gauge how a particular device will work with large amounts of data is to see it in action. Barring that, get references from users with similar applications.

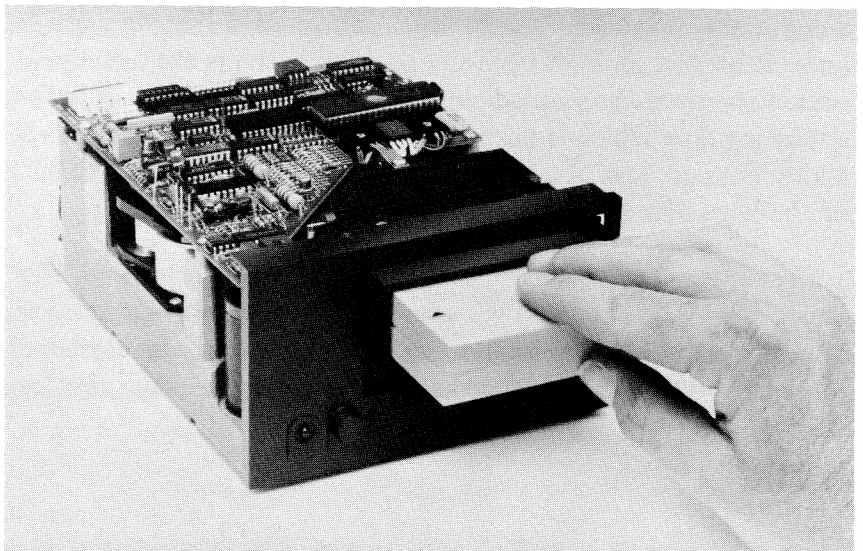
Do I Need to Sort (Alphabetize/Order) Large Amounts of Data?

Hard disks are well suited for applications in which large files must be sorted—sorting a mailing list of 3000 people by zipcode, for example. Some floppy disk systems could not handle this task at all and others would take many hours. If one sorting error occurs on a floppy disk system, you may have to begin sorting all over again.

How Many Computers Will Access Mass Storage?

Almost all multiuser systems use hard disks because of their greater speed and capacity. Videodisks will play a greater role in this application in the future.

Model TM951 Streaming Tape Drive. Courtesy of Tandon Corp.



How Many Tasks (Programs) Must the System Perform Simultaneously?

Nearly all multitasking systems use hard disks because of their greater speed and storage capacity. A multitasking system switches between different programs (tasks) so rapidly that it appears as if the computer is doing several operations at once. A hard disk system can switch programs and data in and out of RAM (internal memory) so fast that processing proceeds with minimal interruption.

What Is the Cost of the Storage Medium (Tape/Floppies)?

Cassette tapes may be purchased for under a dollar. Floppy disks vary from just over one dollar to $10 to $12 each. The average floppy costs from about $2.50 to $5, depending on purchasing volume, quality, and on the supplier. The price of the disk compared to the price of the information stored is minimal. Disks in continuous use should be of high quality in order to avoid error. Some disks are polished very smooth and lubricated to last longer. Hard disks are expensive, and generally cannot be removed from the drive. (Disk packs are removable hard disk cartridges which can be switched in some drives to provide additional programs and data.) Videodisks will probably cost in the neighborhood of $15 each. However, their large capacity makes this expense very economical.

What Provision Is There for Back-Up?

Most floppy disk systems rely on floppy disk back-up. A two-drive system performs this operation more efficiently than a single-drive computer. Hard disks store so much information that they are frequently backed up on tape. Tape back-up systems are usually sold separately from the hard disk drive. Tallgrass provides a built-in streaming tape which is particularly attractive. Corvus requires the additional purchase of a Mirror interface which allows you to back-up the hard disk to video tape.

Is the Storage Medium Reusable?

Tapes, floppy disks, hard disks, and cache disks may be erased and reused. At this time videodisks are not reusable since the laser

"burns" the information into the disk. As the information is discarded or updated, the personal computer uses other areas of the videodisk. Since videodisk capacity is so large, this doesn't pose a problem or increase expense.

What Is the Short-Term/Long-Term Maintenance?

Because of the mechanical nature of tape and disk drives, they require more service than does the personal computer itself. If you have more than one drive, you should use them at frequent intervals to prevent their lubrication from gumming up. According to some service people, unused drives need to be repaired more often than do frequently used ones. Check with other computer users to determine their experience with various products. You may purchase service contracts for disk drives that are in frequent or critical use.

What Warranty Do I Want?

Most warranties last only 90 days. Make sure that the warranty covers both parts and labor. Check to see if local warranty service is available or if you must ship the device to a service center out of town. Be sure to save packing or shipping materials to avoid damage during transit. Freight charges will probably not be covered by the warranty.

What Type of Service Do I Need?

Find out what kind of service the local dealer provides. Does the dealer have factory-trained technicians? Does the dealer stock parts? What is the service turn-around time and quality. References from the dealer's customers are important indicators of service. If the unit is vital to you, the best insurance for uninterrupted service is a spare. Find out if the dealer provides loaners or if you need to purchase an extra unit.

The Checklist Provides the Answers

Once the checklist is complete and rated for priorities, the type of mass-storage unit you require for the application will be clear. Make sure that the features offered by the device are supported by the operating system software.

Chapter 5

THE WORLD OF INPUT DEVICES

The keyboard has been the traditional device used to enter information into the personal computer (see Chapter 2). With the advent of computer games, users needed quick, reliable methods for moving the cursor around the screen—joysticks and trackballs served this purpose quite well. However, as personal computers spread into the hands of people who didn't know how to type, manufacturers had to develop new techniques for entering all sorts of information into the computer.

When Apple released the Lisa and its resident mouse, users started to look seriously at alternative input devices. The light pen and the touch screen fill specialized niches, but haven't become as popular as the mouse. The mouse is a relatively expensive ($200 to $300) pointing device which is a bit more difficult to use for drawing than the light pen or digital tablet. So, digital tablet developers such as Koala Technologies and Chalk Board entered their products into the peripheral market. Digital tablets for home computers cost between $100 and $150, including software. All of these pointing devices communicate position and movement for screen cursor control.

Optical readers fill a void left by cursor control input devices. Many computer users need to "read" optical and printed information. Sophisticated and expensive optical readers actually scan typewritten material and convert the characters into computer code. In the past, these devices cost upwards of $5000. Now, for a reasonable price, personal computer users can buy bar-code readers such

as the Oscar and digital cameras such as the MicronEye. Who knows? computer users may soon be reading "books" written by a robot "dog" named Sparky who speaks "bark-code." More about this later.

The most sophisticated and desirable form of input has always been voice recognition. Everyone's fantasy is to walk up to a computer, speak to it, and have it follow every command. This wish is demonstrated by the lasting reputation of HAL, the computer in the movie classic *2001,* and K.I.T.T. in the popular television series *Knight Rider.* A voice recognition system would probably work in conjunction with a voice output device, called a voice synthesizer (see Voice Synthesizers in Chapter 6). Although personal computer voice recognition devices presently have limited vocabularies and consume enormous amounts of internal memory, manufacturers are making great strides in perfecting their development.

This chapter discusses in detail the three primary types of input, other than the traditional keyboard: cursor controllers, optical readers, and voice recognition devices. In addition, input devices for handicapped computer users are explored. Product reviews for a number of these devices appear at the end of this chapter.

Cursor Controllers

The Mouse: Keyboard efficiency is important for users who input alphanumeric information (letters and numbers). In fact, standard keyboards are not even the best method for accomplishing that task, as witnessed by the use of special keyboards for court reporters.

The mouse is a small, hand-held device which moves on a flat surface such as a desk top. The computer translates the movement of the mouse into corresponding cursor motion on the computer screen. This allows the user to point to an area on the screen, press one of the mouse's buttons, and execute a command. Software design must support mouse operation. For example, the mouse can point at and select items from a menu, move and position objects on the screen and demark text for editing. The user simply moves the mouse and cursor to the proper screen coordinates, pushes one of two to five buttons on the mouse, and lets the computer and the software do the rest.

Mice (some prefer "mouses") are not only convenient to use, they improve input accuracy as well. Error and fatigue are substantially

reduced by pointing to an option instead of typing in text. According to experimental evidence, the mouse seems to be a superior pointing device compared to cursor control keys, joysticks, and light pens. I'm not sure, however, that I'd want to play Pac-Man with a mouse.

Mechanical mice move on wheels or a ball. Apple's Macintosh uses a mouse with wheels. Mice can be used on almost any surface and suffer only mildly from slippage. Moving a mechanical mouse on a diagonal path isn't as easy as moving an optical mouse. The mechanical mouse has higher resolution (200 parts per inch or more) than the optical mouse (100 parts per inch).

The optical mouse uses a laser light to keep track of its movement. For example, PC-Mouse glides across a grid-surfaced pad. Reflected light from the pad communicates to the computer where the mouse is moving. The computer translates this directional and speed information into corresponding cursor movement on the screen. Some prefer the mechanical mouse because they don't have to restrict its movement to the pad area. Others claim that a mechanical mouse will wear out before an optical one will. Most of these claims seem to be made by opposing manufacturers, not by users.

Remember that mice need special software and often require a hardware interface. Some mouse manufacturers provide this support and others don't. Presently, not much software is available for mice; however, the volume is growing rapidly.

The appendix in this book lists a number of mouse manufacturers. Since most mice are computer-specific, I didn't review each mouse. A review of the PC-Mouse for the IBM Personal Computer appears in the Review Section of this chapter.

Light Pens: Light pens resemble felt-tipped markers with cords coming out of the back end. Depending on the computer and pen, this cord may plug into a joystick port (Atari and Commodore) or into a light pen port (IBM PCjr). By pointing directly at the CRT screen, the user controls the cursor position and movement. The user can point to a menu selection, draw lines on the screen, and manipulate objects. Some people think that the mouse is a better pointing device, since reaching up to the screen with a light pen is tiring. Also, if the pen is pointing to a particular character, it may obscure the user's vision. Others feel that pointing to the screen instead of moving a mouse on the table is more precise; for example,

children don't have to translate horizontal hand movement into screen coordinates.

The better light pens have a switch on the barrel which turns the pen on and off. The L-PC Lite Pen has a spring-loaded tip that turns the pen on when the user presses it against the screen. The Edumate light pen is activated by keys on the keyboard (not the best configuration, since the user's eyes must leave the screen to find the correct key).

A number of inexpensive light pens such as those of Edumate and Tech Sketch are being used for educational applications. These manufacturers provide software to support their products. More software is needed before light pens become popular input devices.

Digital Tablets: I've had more fun drawing on a digital tablet than almost anything else I've done with a personal computer. A digital tablet is a flat, rectangular surface, under which is a fine matrix of electrical switches. Each row and column coordinate corresponds to a screen coordinate. Depending on the software, touching the tablet surface results in some action on the screen. The tablet is a pointing device similar to the mouse. By moving a finger or stylus across the touch-sensitive surface, the user communicates position and motion information to the computer.

The digital tablet can be used to select menu items. For example, Micro Illustrator, an extremely fine graphics program, presents a number of drawing and color options to the user. The user makes menu choices by placing the stylus on the Koala Pad digital tablet and pressing a button on the tablet frame. Once the user has selected "pen size" and "color," the stylus and tablet replace crayon and paper. The user can create professional-quality computer graphics or just have a good time.

Some digital tablets allow the user to place overlays on the touch-sensitive surface. These overlays define areas of the surface for specialized "keyboard" input; for example, the Keyport 717 has an overlay and utility program that defines keys (points or areas on the pad surface) corresponding to the BASIC computer language; for example, a single "key" might mean LIST or RUN. The Keyport 717 can be transformed from a BASIC programming keyboard to an educational game by installing a different program with its corresponding overlay; for example, "The Animal Farm." In this configuration, the preschool youngster can point at parts of the picture

overlay and match colorful screen graphics. The versatility of digital tablets is just beginning to be explored.

Joysticks: Almost everyone is familiar with joysticks. Joysticks control cursor position and movement. Some joysticks control motion in 360 degrees, others in eight directions, and still others have collars or gateplates which limit movement to four directions (handy for working maze games).

Joysticks have one or more "firing" buttons which allow the user to shoot down flying saucers, make menu selections, and activate drawing routines. These buttons may be located on the top of the handle or on the base. Left-handed users may wish to check out different models since a number of manufacturers do provide for both right- and left-hand button operation. Some firing buttons give very little tactile feedback, and the amount of button travel varies from one model to another. A trigger with a long throw may be tiring to use. Make sure that the button is responsive and comfortable to use.

The handle or grip may be shaped like a baseball bat, may be a rod with a knob on top, or may be a contoured finger grip. Some handles are large to fit adult hands; some are small to fit small hands.

Joysticks may have long cords, short cords, coiled cords, lightweight cords, and reinforced cords. Fancier models operate the computer from across the room by remote control. The cord is probably the weakest point in the joystick and is the source of most service problems.

Some joysticks are designed to fit comfortably in the user's hand. Others are neither comfortable to hold nor to operate on a table. They may have sharp corners or be too large to hold. Table models are equipped with suction cups or are weighted so they won't slide around. One unique design doesn't rely on relative positioning between a stick and base. Instead, it senses tilt—forward-backward and side-to-side.

A joystick may have a home or vertical position. Some have switches that release the spring-loaded homing feature so the stick stays in the desired direction until the user moves it.

Trackballs may be used like joysticks to control the cursor. The ball spins in ball-bearing rollers and conveys direction and speed to the computer through an optical reading device within. Some users

like the effect created by spinning the ball. Since this spinning ability and the "feel" of the ball vary between brands, users may wish to try out the trackball before buying.

Most joysticks are designed to operate with specific computers. I chose not to review specific brands but to alert users to features common to many different types. Some of the popular joystick manufacturers are listed in the appendix in the back of the book.

Optical Readers

Bar Code—The Universal Mass-Storage Language: Some believe that bar code is the archival storage wave of the future. It is permanent, easily retrieved, and inexpensive. It cannot be magnetically altered and won't deteriorate with time. Making copies of bar code with a copy machine is easy. And the process for converting the printed bar code to digital information is accurate and relatively efficient.

At this time not many personal computer companies are taking advantage of this optical-reading technology. However, businesses are beginning to use this very versatile and accurate input device to keep track of inventory, create point-of-sale tickets, and simplify data entry.

The introduction of the Oscar bar-code reader for popular computers like the Commodore and Atari will open up new avenues for bar-code use. For example, magazines can print program listings in bar code instead of alphanumeric characters that must be typed into the computer. Reading bar-coded program listings is not only much easier but much less prone to error than keyboard entry.

The visually handicapped may find that bar code is a viable alternative to Braille. Coupled with a voice synthesizer, a bar-code reader allows users to sense the text with the bar-code reader and hear it read by the synthesizer. Texas Instruments already sells an inexpensive but effective bar-code reader and voice synthesizer designed to support a series of children's books. The entire package is no larger than the Speak And Spell unit they introduced a few years ago.

Digital Cameras: Don't worry about trading in your Leica for the MicronEye digital camera yet. Inexpensive digital camera technology isn't quite up to a camera buff's expectations. However, a com-

puter enthusiast can have a lot of fun experimenting with digital photography. Businesses use digital cameras for character recognition, signature verification, gauge monitoring, inspection, surveillance, motion detection, time photography, bar-code reading, and robot vision. As digital cameras improve and the software becomes commonly available, more people will be considering innovative uses for these optic sensors. A review of the MicronEye digital camera appears in the Review Section below.

The Growing Voice Recognition Market

Voice recognition is being used for toys, video games, appliance control, data entry, security systems, and telephone communications. Lifelike, voice-equipped toys and personal computers will contribute most to the growth of this industry, expected to reach $4 billion by 1992. Voice technology also makes keyboarding more efficient and boosts productivity.

Voice input provides invaluable help to operators whose normal tasks require extensive and precise eye-hand coordination. The user orally instructs the computer without interfering with the manual task.

There are three categories of voice recognizers: (1) speaker-dependent, (2) speaker-independent, and (3) continuous-speech.

Speaker-dependent devices recognize isolated words. The computer synthesizer is "trained" to recognize a limited number of sounds or words from a specific individual. The device then matches a sound to a prerecorded voice template in order to register the meaning. Even recognizing a simple "yes" or "no" or the numbers one through ten give the operator great audio input flexibility with properly designed software.

The new speech recognition keyboard from Key Tronic may provide a breakthrough for personal computer users. With the voice-recognition keyboard installed, data enters the host computer from the standard keyboard or from the speech recognition unit. The origin of the data is transparent to the host computer. The microphone detects an audio bandwidth from 200 to 7000 Hz. Once the sound is converted into an analog signal, it's amplified and filtered before being fed to the speech recognition chip. During word training, patterns (templates) are derived for each vocabulary utterance. Template data is stored in the computer RAM. The processing

algorithms (formulas designed to decode the information) reside in the recognition/control program stored in the EPROM (permanent storage circuits). The user may save up to 100 discrete "utterances." The Voice Utility Program allows a user to create a vocabulary, train it, test it, and to upload and download it. In the Application Mode, spoken words are transformed into strings of keypresses. In this way the Key Tronic voice recognition keyboard can be used with any existing software.

Speaker-dependent voice recognizers are known for their high accuracy and low cost. Speaker-independent recognizers are mainly used for telephone applications where the system must perform for all callers.

The voice-recognition process consists of four basic steps: (1) sampling of the analog waveform (voice or noise); (2) identifying the word end-points (pauses between words); (3) statistical analysis of the waveform (matching, averaging, and analyzing with algorithms); and (4) confirmation by voice synthesis or screen display.

The advantages of voice recognition are that it is the most natural communication method, requires minimal training, has very high output capacity, makes the speaker accountable for accuracy, provides for simultaneous functions, is unaffected by most hostile environments, and doesn't restrict nor is it restricted by the user's mobility. Voice recognition may be adversely affected by speaker inconsistency and may not respond economically to a large and varied vocabulary. Extreme noise conditions may also affect input.

At the beginning of 1983 there were at least 86 vendors offering more than 125 voice recognition products. I did not review any speech recognition devices since at present they are very expensive, computer specific, or still under development. A partial list of voice recognition developers appears in the appendix.

Freeing the Handicapped

46,000,000 U.S. citizens have some degree of disability. Of these, 7,000,000 have impaired activity, 50,000 are quadriplegic, and 1,500,000 intelligent people are nonvocal. Every year 100,000 adults suffer permanently disabling work injuries and 10,000 new-born babies are crippled with cerebral palsy. The personal computer is literally freeing these minds—minds which, until now, have been trapped in unresponsive bodies. If the handicapped individual can control *one muscle,* he or she can operate a personal computer.

Special keyboards like those manufactured by Key Tronic allow one-finger operation. The CONTROL and ESCAPE keys have lock features to void the necessity of multiple-hand and finger operation. Even a mouth stick can be used to operate this keyboard. The Microwriter, a one-handed stand-alone word processing machine (reviewed in Chapter 2), can be used by handicapped individuals who have the use of their right hand.

Joysticks and digital tablets provide simple methods for computer input by the handicapped. An infrared video camera detects eye position for identifying screen coordinates. An optical switch is activated when a light beam is broken. Pneumatic switches make contact when a quadriplegic sips and puffs on a plastic tube. A light pen mounted on the user's head points at the screen. A touch screen responds to a pointing finger or mouth stick. A bite switch responds to gnashing teeth. A mercury switch communicates information from a tilting head. A speech recognition device translates sounds into computer commands. An ultrasonic sensor detects position and helps control an electronically guided wheel chair.

None of these devices are extraordinarily expensive or complicated. Many must be supported by customized software developed by companies or by computer hobbyists such as the Handicapped Users' Group of the Tulsa Computer Society.

Once the handicapped user begins communicating with and controlling the personal computer, a world of possibilities opens up. A nonvocal quadriplegic can write messages, print correspondence, complete school lessons, "talk" on the telephone with a synthesizer, catalog and retrieve information, control appliances, move about, control a robot, and exercise atrophied muscles.

Specific input devices for the handicapped are not reviewed in this book since many are computer specific or custom designed. Rehabilitation centers, located around the country, can advise interested parties on personal computer peripherals for the handicapped.

SUMMARY

The nonkeyboard world of input includes cursor control devices, optical reading devices, and voice recognition devices. As software is developed to support these alternate controllers, more computer users, including the handicapped, will be able to take advantage of the computer's convenience and power.

Cursor Controllers

POWERPAD

Chalk Board, Inc.
$99.95

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Excellent
Usage: Home - Excellent

FEATURES
12 in. × 12 in. touch surface
100 switches per square in.
120 switches per horizontal row and vertical column (14,400 digital switches)
Interface: Joystick ports (Atari/Commodore); $50 starter kit needed for Apple/IBM
Overall Dimensions: length 19 in. × width 21 in.
Weight: 4.5 lbs.

The Powerpad is a much larger graphics tablet than the KoalaPad. Size is both an asset and a liability. Very small children with less motor coordination will enjoy drawing on the larger surface. A class of handicapped youngsters in Tulsa, Oklahoma, is using the Powerpad as an input device with the Atari 800 computer. However, the Powerpad occupies more space than the KoalaPad. Although the size may be an advantage for younger children, the speed is too slow. Normal drawing speed creates a dot-to-dot effect on the screen rather than continuous lines. Since the pad substrate is composed of tiny switches which are individually activated, the user can draw in more than one spot at a time. This is an advantage, for example, in the program "Music Maestro," which lets the user play chords as well as single notes.

Most of the Powerpad programs are educational games available on cartridge. Membrane overlays mounted in a plastic frame snap into the Powerpad. Although the overlays look fragile, they're durable. Often these overlays correspond to the screen display; for example, "Music Maestro" pictures a musical staff on the upper portion and a piano keyboard below.

Instead of mechanical buttons on the border (KoalaPad), Powerpad puts its many switches on its sensitive surface. The overlay designates where the switches are and what function they serve.

Chalk Board plans to include more than 30 educational packages in their line including art, music, math, science, language arts, and social science. Most of the packages including the overlays cost $25 to $50. Replacement overlays are $6. The Powerpad isn't bundled with a software package like the KoalaPad; however, "Micro Illustrator" is now available for about $50. A programmer's kit has a blank, erasable overlay that works well with a grease pencil.

SUMMARY

Powerpad offers a larger-surfaced digital tablet which is particularly appropriate for users with less coordination and motor control, for example, very young children and the motor handicapped. A grid of switches offers the versatility of input from more than one spot at a time. For drawing, however, the switches operate too slowly and therefore tend to leave gaps in continuous lines. The variety of educational programs makes the Powerpad an attractive accessory.

EDUM...

Futurehouse, Inc.
$29.95

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Poor; Hacker - Good
Ease of Use: Adult - Good; Child - Poor
Usage: Home - Fair

FEATURES
Available for Atari 400/800; Commodore 64; IBM PCjr
6-in.-long-pen plus coiled cord
Software: Demo program disk

The Edumate Light Pen runs on a Commodore 64 with a disk drive. The software contains Draw Routine, Disk Utility, 3D Tic-Tac-Toe, and Pen Music. Draw Routine allows the user to use the light pen to draw images on the CRT screen. The Disk Utility permits disk operations such as formatting and deleting a file. The 3D Tic-Tac-Toe displays a 4 × 4 cube and allows the user to play against the computer. Pen Music displays eight octaves of note tables, so the user can use the pen to select the waveform and duration for each piece.

Instructions for using the programs averaged 150 words each and were easy to read, but there was not enough error/escape information for beginners.

Using the pen is somewhat irritating since the cord is too heavy for the pen. Overbalancing made it difficult to put the pen on a table without it slipping to the floor.

The pen is very sensitive, so it responds up to 6 in. from the screen. Since the pen only communicates with the computer when a key is pressed on the computer, the user has precise drawing control. Touching a single key on the keyboard changes the line color or clears the screen. Control codes are not required. Drawing is easier than erasing, and is also the best application, since it's fun and easy to do. The manufacturer does not provide a method for saving pictures to the disk.

Using the light pen to control moves in a game and to select options from a menu is easy. Since the pen is only activated when a key is pressed, the user has good control.

Music application is frustrating. Making noise is easy, but the directions on the screen and in the documentation are not clear as to how to make distinct notes. Also, there's no provision for saving composed music to the disk.

3D Tic-Tac-Toe shows only one of the four levels at a time, which would confuse and frustrate most children.

The Edumate Light Pen offers an excellent opportunity for the hacker, since the documentation does provide enough technical information for him. The demo programs illustrate the general kinds of uses for the light pen, and the package is inexpensive enough to tempt the experimenter wanting to explore this type of hardware.

SUMMARY

The Edumate Light Pen works well for drawing applications, but using the pen is awkward due to the heavy cord. The user activates the pen by pressing a key on the keyboard. The demo programs serve as an orientation to light pen functions, but leave a lot to be desired for most adults and youngsters. The documentation is sparse but adequate for the hacker. The manufacturer offers many other software products; however, since the quality of the demo programs and documentation is so poor, I'd hesitate to order them.

KOALAPAD TOUCH TABLET

Koala Technologies Corp.
Atari: $99.95; Apple: $125; Commodore 64: $99.95; Commodore VIC-20: $99.95; IBM Personal Computer: $99.95; IBM PCjr: $149.95

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Excellent
Usage: Home - Excellent; Commercial - Good

FEATURES
Resolution: Typically 256 points per x-y (Apple)
Interface Options: Game paddle (variable resistor); RS-232C (special); Custom (on request)
Overall Dimensions: width 6 in. × height 8 in. × depth 1 in.
Active Surface - width 4.25 in. × height 4.25 in.
Software: "Micro Illustrator" graphics drawing program (disk); Koala Painter (disk) graphics drawing program for PCjr
(Note: Future models will be equipped with cartridges.)

The KoalaPad touch tablet is so easy to use that I didn't even read the instructions until I wrote this review. We bought it for our Atari 800 last Christmas. Even our six and ten year old children took to it with minimal instruction.

The KoalaPad. Courtesy of Koala Technologies Corp.

The KoalaPad. Courtesy of Koala Technologies Corp.

The KoalaPad is a position-sensing device that converts finger or stylus pressure and movement into electronic signals for controlling computers. The pad is particularly useful for drawing pictures and pointing to images on the CRT (TV) screen.

Depending on the software, this input will command the computer to move a cursor, activate a menu choice, or draw a line. The Micro Illustrator graphics package provided with the KoalaPad demonstrates many of the pad's applications. Much of the software that works with the Apple computer game paddles will also work with the touch tablet.

The manual gives detailed instructions for installation of the pad on each type of computer. A small BASIC program, provided for each computer, tells the user how to read data from the touch tablet. This allows the pictures to be incorporated into user-written software programs. The KoalaPad manual is quite adequate and well written. The differences between the two buttons on the tablet is not spelled out. The use of these buttons requires that both hands be occupied—one for the stylus and the other for the button.

Micro Illustrator—the Real Star

The electronic drawing software together with the KoalaPad allow the user to (1) draw freehand, (2) design geometric shapes, (3)

change colors, (4) create scrolling rainbow effects, (5) draw mirror images, (6) magnify the drawing for detail work, and (7) save the designs for future use. When the program is loaded, an icon-like menu is presented for the user's choice: draw, point, line, K-line, rays, fill, frame, box, circle, disk, erase, storage, mirror, magnify, and color menu. Across the bottom are nine "paint-brush" sizes and shapes and a HELP box. Four rectangles across the bottom are filled with colors for the user to paint with. Colors may be selected from the color menu. At the bottom are textured patterns composed from the four colors. Menu selections are made by moving the stylus on the pad until the screen cursor locates the item on the menu. The selection is made by pushing the button. Even a nonreader (my six year old) can learn to operate this device and software package.

The disk contains a number of sample pictures which can be viewed and studied for technique.

The manual explains quite clearly how to use Micro Illustrator. The user won't have to memorize any complex control codes or confusing command sequences. A brief glossary offers additional help.

SUMMARY

The KoalaPad touch tablet together with the "Micro Illustrator" graphics software provide many hours of pleasure and entertainment. The quality of graphics is so good that many programming professionals use this system to produce illustrations for games and other software packages. An artist can produce very impressive pictures, which can easily be saved to disk and transferred to other programs. The procedures are so simple that a nonreading child can learn to perform all of the operations. The graphics package would be improved if the user could create a library of commonly used symbols from which items could be selected, for example, a library of flow chart symbols or electronic component symbols. Also, it would be nice if the loading of pictures could be chained to present a simulated "slide show."

PC-MOUSE

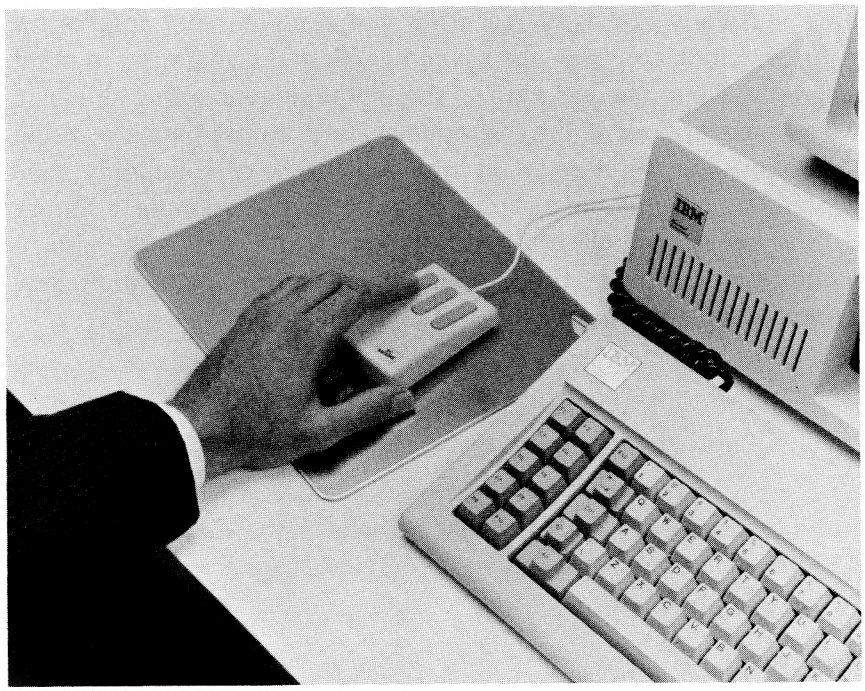
Mouse Systems Corp.
$295

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Poor; Hacker - Fair
Ease of Use: Good
Usage: Commercial/Home - Good

FEATURES
Compatible with all PC compatibles; PC-DOS 1.10 and 2.0
Interface: RS-232C serial
Baud Rate: 1200 (2400 optional)
Wall-mounted power supply
Sensing Mechanism: Optical (senses grid on special pad)
Pad: 9 in. × 11 in. grid
Switches: 3, located on top of the mouse

The mouse is a hand-held device that when moved across a surface translates the hand motion into cursor motion on a computer screen. The mouse allows the user to point to an area on the screen and then to press one of its buttons to execute a command. The PC-Mouse is an optical mouse which uses a reflected light to sense its

The PC-Mouse. Courtesy of Mouse Systems Corp.



movement across a grid-surfaced pad. The user plugs the mouse into the IBM RS-232C port (COM1 or COM2).

Because the IBM display isn't bit-mapped, the cursor movement on the screen is character-by-character or line-by-line, instead of in a smooth unbroken motion. The movement of the mouse is precise, positive, and silent. The PC-Mouse works fine. However, the documentation only tells how to use the device with very specific software: the Personal Editor, WordStar, Lotus 1-2-3, VisiCalc, Multiplan, and Volkswriter. Installation programs are provided so that the PC-Mouse will work with the above programs. (I couldn't get it to work with WordStar, however.) Good illustrations show how to assemble the mouse components.

The technical manual contains much information that should appear in the user's manual; for example, "Don't leave the pad in direct sunlight." And, "Unplug the unit when not in use." The manual also explains how the PC-Mouse can be used as a digitizer by putting a transparency over the CRT screen. Exact details for this process are omitted.

The pop-up menus described in the manual sound easy to use and helpful. The buttons on top of the mouse allow the user to execute instructions; for example, in WordStar, the button on the left gives a pop-up edit menu, the middle button moves the cursor in the text, and the button on the right gives a file pop-up menu. Unfortunately, the use of the buttons isn't standardized from program to program. By moving the mouse on its pad, the user can quickly move the cursor to the menu selection, push a button, and proceed to the next operation. I found that staying within the limits of the pad boundaries wasn't confining. In fact, the optical locating process prevents skipping due to slippage, which is often found with mechanical mice. On PC Crayon, the mouse was too sensitive. A small shift of the mouse moved the cursor too far and sounded an alarm.

SUMMARY

PC-Mouse is a very good peripheral that can be used with specific software packages on IBM-compatible computers. Initialization programs are provided for popular business software. However, the documentation doesn't tell the user much about using the mouse with other software applications. The graphics limitations of the IBM-PC cause the cursor to move character-by-character or line-by-line instead of in a smooth, continuous pattern.

KEYPORT 717 PROGRAMMABLE KEYBOARD

Polytel Computer Products Corp.
$179.95

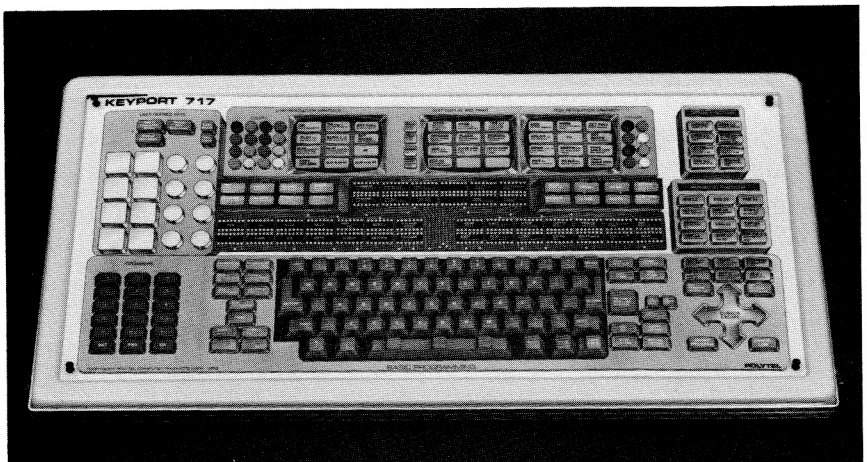
PERFORMANCE RATING
Performance: Good
Documentation: Fair
Ease of Use: Novice - Good; Programmer - Good
Usage: Home - Excellent; Business - Good

FEATURES
Number of Keys: 717, programmable
Membrane Overlays: 11 in. × 24 in. (preprinted and blank matrix)
Connector: 16-pin DIP; game port
Cable: 5 to 50 feet
Software: Utility programs with BASIC overlay
Dimensions: 12 in. × 25 in. × 2 in. (storage compartment below keyboard)

The Keyport 717 is an 11 in. × 24 in. matrix with 717 programmable switches. A printed plastic overlay, placed over the membrane keyboard, tells the user which area of the keyboard does what. Since each of the 717 keys is programmable, the user can tailor keyboard design and overlay layout for specific software.

Menus, command sequences, and functions printed on the overlay provide easy program operation. For example, one overlay allows the user to program a series of print statements for a BASIC program by pressing one key to enter the string closed quotes, new line number (auto line number), the command PRINT, and the string open quotes. The programmer types in the string to be printed and then presses this special key to do the rest. On the BASIC overlay, a

The Keyport 717. Courtesy of Polytel Computer Products Corp.



group of small colored keys allow the user to enter the BASIC color code numbers. For example, pressing the yellow key would result in "Color 13" being entered into the program. These capabilities save a lot of time and reduce the chance for error. The Keyport doesn't disable the standard keyboard, so text may be typed using a word processing quality computer keyboard. Polytel provides a programmer kit which includes utility programs and blank overlays.

A BASIC programming overlay for AppleSoft BASIC and DOS commands comes with the Keyport. A VisiCalc template and overlay can be obtained for $39.95 (but must be purchased separately). A colorful early child development program, called "The Farm," is included in the basic package. Currently, the Keyport works with Apple, the Tandy Color Computer, TI-99/4A, and IBM-PC. More hardware interfacing and software packages are being developed.

The physical size of the Keyport 717 may be a disadvantage for some. It is a bit large to put in your lap and takes up most of the space on the desk. However, the size is an advantage in that a great deal of information and flexibility can be built into the overlays and programs. Very small youngsters and handicapped people with coordination or visual problems can use the Keyport for computer input. For example, The Tulsa Computer Society Handicapped Users' Group has written a ten-key calculator program for the Keyport. The large overlay is a magnified ten-key pad. The user can strike the surface with a fist and still operate the computer.

A programmer complained that troubleshooting was hampered because he couldn't view previously saved keyboard programs—Polytel was very responsive to his questions and to a minor service problem.

The documentation is a 3-page data sheet plus a 30-page programmer's reference guide.

SUMMARY

The Keyport 717 is an excellent digital tablet designed to be a programmable keyboard. Overlays provide menus, command sequences, function keys, and other information that relieves the user from memorizing codes. Since each key can perform multiple functions, the Keyport cuts down on the number of entries required to write a program or run a software package. The footprint is fairly large and may be inconvenient for the typical desk or an average lap. At this time software from Polytel is rather limited. Much more will be available in the near future.

LP-10S LIGHT PEN

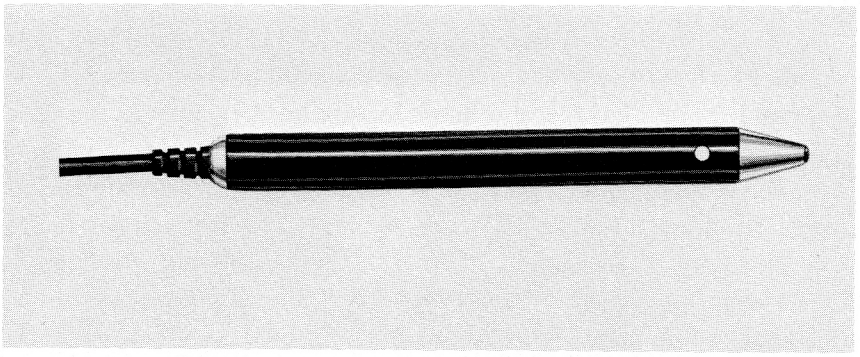
Tech Sketch, Inc.
$39.95 (including software); Apple requires a $99.95 interface card

PERFORMANCE RATING
Performance: Good
Documentation: Good
Ease of Use: Adult - Good; Young Child - Fair
Usage: Home - Good

FEATURES
Pen Size: 3.25 in. length
Push-button switch on pen barrel
Cable: 3 feet, with molded plug for joystick port
Models: Atari, Commodore, Apple, IBM
Software: Bundled with "Paint 'n' Sketch," Level I

Light pens are fun and provide a unique way to interact with the computer. With the proper software, they can be used to draw pictures on the screen, select options from a menu, and manipulate images. The Tech Sketch light pen is a very inexpensive input device, considering that it's bundled with a good (though not elaborate) graphics software package. Tech Sketch also has other software available, including "Micro Illustrator," "Alphabet Fun for the Young," "Number Fun for the Young," "Connect a Dot," "Shape and Color Recognition," "Piano Player," and "Simon Sez." Each of these packages is available on cassette or disk and average $15 to $20 each. "Micro Illustrator" together with the pen costs $69.95 for the Atari and Commodore 64. (See the KoalaPad review for description of "Micro Illustrator.")

The LP-10S Light Pen. Courtesy of Tech Sketch, Inc.



Some people prefer a light pen to the mouse or graphics tablet. It's natural to point directly at the item you desire on the TV or CRT or to draw on the screen as you would with a pencil. However, the Tech Sketch, as well as other pens, must be positioned vertically to the screen. If the pen is cocked at an angle, the computer may not sense the information correctly. This is an awkward position for many people to maintain, especially children. The button on the pen barrel turns the sensing capabilities on and off. The pen is very precise, and easier to draw with than the Edumate Light Pen. However, this very sensitivity makes the Tech Sketch difficult to use with selection menus. I had to try repeatedly to get the pen to register a menu selection. When I used the same software with the Edumate pen, which has a broader sensitivity, the menus were easier to access. The television screen brightness and contrast controls had to be adjusted very precisely for the pen to work. The pen had to be calibrated at the beginning of the drawing program.

An adult might be willing to cope with these performance requirements and problems, but my six year old won't tolerate unresponsive menus for very long. Since the primary software support is directed at children, I feel that this is a drawback unless the parent plans to sit with the child and help with menu selection, menu reading, and operation.

The software isn't elaborate but is nicely done. The graphics are good and the sound effects are cute. I got tired of the sound effects by the thirtieth state in the "States and Capitals" program, but this may not be a problem for children.

SUMMARY

The Tech Sketch light pen is an inexpensive input tool which works well for adults, but with some difficulty for young children. The preciseness of its sensitivity makes it better for drawing than the Edumate. However, it is very sensitive to screen brightness and contrast controls and requires some fiddling with to register menu selections. If someone wants to see how a light pen works, the $39.95 price, including "Paint 'n' Sketch," is a bargain. The other software may be a bit overpriced.

Optical Readers

OSCAR—OPTICAL SCANNING READER (BAR CODE)

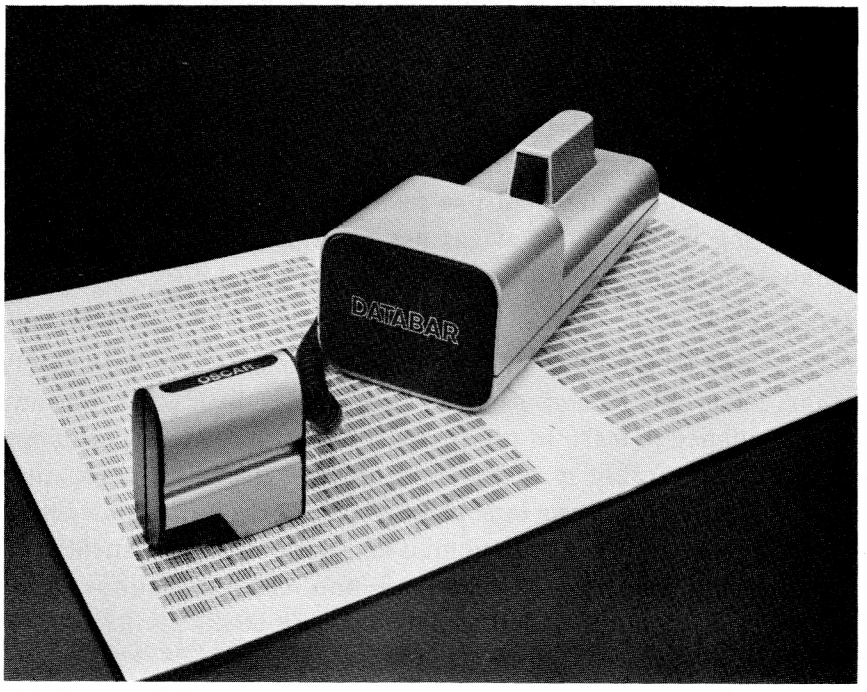
Databar Corp.
$79.95

PERFORMANCE RATING
Performance: Good
Documentation: Hacker - Good; Novice - Fair
Ease of Use: Hacker - Good; Novice - Fair
Usage: Home - Good

FEATURES
Computer Compatibility: Atari 400/800/XL Series; Commodore Pet, VIC-20, and 64; Timex-Sinclair 1000; Radio Shack TRS80 Color Computer; TI 99/4A; IBM PCjr
Self-contained unit with reader attached by coiled cable
Reading template
Software: Built-in
Interface: Cassette tape port; Cable to cassette tape port
Power Supply: 4 "D" batteries (not included); Automatic shut-off after 60 seconds of nonuse
Indicators: LED power on
Audible Signals: Line of code read correctly; Line of code read incorrectly; Skipped line of code/wrong line; Program entry complete; Low-battery voltage; Buffer full/dumping to computer
Dimensions: Reader only - Height 2.5 in. × length 2.5 in. × width 1.25 in. Overall unit - Height 3 in. × length 9.5 in. × width 4 in.

Some people believe that bar code is the archival storage wave of the future. Bar code is permanent, easily retrieved, and inexpensive. It cannot be magnetically altered and won't deteriorate with time. Making copies with a copy machine is easy. And converting the printed bar code to digital information is accurate and relatively efficient.

Databar provides "printed" software and a monthly magazine that lists programs in a special, condensed bar code. By moving Oscar across the bar code, the user can read the program listing into the computer and store it to disk. If the user doesn't have a disk, the bar code must be read into RAM each time the program is used. Databar makes reading as easy as possible by providing a template which defines the boundaries of each line of code. It took me quite a



Oscar Bar-Code Reader. Courtesy of Databar Corp.

bit of patience, persistence, and practice before I could use Oscar efficiently. Timing or reading speed is more critical than the advertising suggests. Oscar gave me an audible buzz when I made a mistake; for example, if I skipped a line, Oscar let me know I was reading the wrong line.

Every five lines or so Oscar must dump his buffer memory to the computer. A low buzz signals this action, during which Oscar will not accept more data. Sixty seconds after reading stops, Oscar turns himself off to preserve the batteries.

The manual and illustrations are very good, but, since the procedures are rather complex, the loading instructions are at times confusing. The updated user's manual corrects this problem. The manual has a good troubleshooting guide and lists an 800 number for customer service.

At present Oscar can only read Databar's programs. But Databar is marketing individual programs for about $10 through software shops. Each issue of *Databar Magazine* contains eight programs and a number of helpful articles. A subscription is $120 per year, each issue costs $15, or less than $2 per program. Program categories include Funware, Wordware, Healthware, Legalware, Scienceware,

Homeware, Classware, and Genware (BASIC programming tutorials). Databar has a strong educational and nonviolent game base. The graphics are colorful although not spectacular, probably because so many different computers are supported. The programs are some of the most intelligent I've seen. In fact, Databar is currently negotiating with popular magazines to print program listings and database records in their bar code.

SUMMARY

Databar's Oscar is an inexpensive and reliable bar-code reader which reads only its own particular brand of code. It takes time and some patience to learn to use it well. The manufacturer provides a template, a monthly magazine, and printed programs compatible with the reader. Plans include printing information in popular magazines. Bar code provides a unique long-term and permanent storage medium that is easily copied and converted into digital information. Oscar is more than a toy—it may be the input device of the future.

MICRONEYE DIGITAL VIDEO CAMERA

For the Apple II Plus, IBM PC, Commodore 64, or Radio Shack Color computers
Micron Technology, Inc.
$295

PERFORMANCE RATING
Performance: In good lighting - Good; In low lighting - Poor
Documentation: Excellent
Ease of Use: Hacker - Good; Novice - Good/Fair
Usage: Commercial - Good

FEATURES
Resolution: 128 × 64; 256 × 128; 512 × 256
Interface: Serial TTL; 300 to 153,600 bits per second
RS-232C; Factory set at 9600 bps
16-pin DIP connector on back of camera
Cable: 16-wire ribbon - 4 feet; RS-232 - 6 feet (up to 25 feet)
IS32 OpticRAM: Dual 128 × 256 element arrays; 32,768 light-sensing elements per array
Adjustable light sensitivity
Variable scan rate
Fully TTL compatible
Wide dynamic range
High-Resolution Images: 15 frames per second (67 ms/frame)
Built-in collapsible tripod
Software: Unprotected/listable/menu driven
Dimensions: Camera - diameter 2.75 in. × length 2.5 in.
Tripod (legs extended) - diameter 8 in. × height 7 in.
Lens: 16mm; f1.6 (approx 2:1 telephoto)
Focus: 18 in. to infinity; Lens spacer allows focus as close as 1 foot

The MicronEye is a low-cost imaging system that is easily interfaced with popular personal computers. The solid-state camera functions as both a still and motion picture camera. Although a home user might consider this input device to be an expensive toy, business users may think otherwise. The MicronEye is used for character recognition, signature verification, gauge monitoring, inspection, surveillance and motion detection, time-lapse studies, robot vision, and bar-code and OCR reading.

The 120-page operator's manual explains more than most users will want to know. Many technical drawings and charts explain

MicronEye Camera, RS-232. Courtesy of Micron Technology, Inc.

how the camera is built and operates. Hardware and software developers will appreciate the attention to detail. The software provided is unprotected and listable, which encourages users to develop their own programs. However, I couldn't find any instructions on how to freeze an image and store it on tape. I would have appreciated more information on how to take pictures and achieve gray scales. The Grey16 program, which takes 16 different pictures at 3-second intervals, makes the best pictures. Grey Screen programs take only two exposures, which aren't enough to get a good gray scale.

How Does It Take Pictures?

The OpticRAM must be refreshed every so often or it loses data. Each storage (bit) location in the memory resembles a tiny capacitor (battery), which slowly loses its charge. When light falls on the surface of a dynamic RAM, this discharge rate accelerates. The MicronEye utilizes this photosensitive property to sense light and dark images.

Light reaches the chip surface through a rectangular quartz window located behind the camera lens. First, the data in every memory location is set to a logic 1 value. When light focuses on the chip, the

affected storage cells discharge at an accelerated rate. As a result, the memory locations receiving light lose their charge and change from logic 1 to logic 0. On the graphic screen, the 1 represents a white dot and the 0 a black dot. In this way the MicronEye converts light and digital data into a graphics image on the CRT screen.

Software Assistance

The menu-driven software driver lets the user begin operating the camera quickly. The user can control the light-sensitivity, exposure times (.001 to 60 sec.) and automatic exposure, save and load pictures from a disk, and print pictures on a graphics printer such as the Epson. The software can be listed and copied. Documentation and comments encourage the user to make modifications.

Portraits a Bit Difficult

The high-contrast picture produced by the MicronEye causes difficulty for the digital portrait photographer. After some experimentation, I found that the face must be lighted from the front at an angle to create the shadows which reveal facial features. Low lighting levels are inadequate, and bright lighting wipes out detail. Taking pictures of black and white photographs created similar problems. The MicronEye covers a very narrow area; for example, at 10 feet I took a picture of a 5 in. × 7 in. photograph that printed nearly 2 in. × 3 in. Taking self-portraits was difficult, since I had to program a delay loop, run to the spot I thought was correct, and hold still for almost a minute.

A longer cable would be very helpful: Instead of taking everything to the computer and camera, the user could take the camera to the subject.

SUMMARY

The MicronEye is truly a unique input device and probably one of the first low-cost, digital cameras. As applications develop and software becomes available, many more digital cameras will enter the market. This camera was difficult to adjust in low lighting. The high contrast output made distinguishing facial features difficult. The Grey16 software provided gave the best images. With some experimentation, an inventive user can get a lot of mileage from this device.

Chapter 6

The World of Sound Devices

The television set, monitor (CRT), and printer are the traditional devices used to see what the personal computer is doing (see Chapters 1 and 2). As personal computer consumers make more demands on the market, a wider variety of output devices is becoming available. Consumers are now demanding more sophisticated entertainment and greater user-friendliness. What could be more user-friendly and more fun than a computer that sings and talks to you?

Voice synthesizers are now reasonably priced and work pretty well. For $150 to $500 you can get hardware and software that is flexible and reliable. Music synthesizers tend to be more expensive—usually from $600 to $2000, and up. Unlike voice synthesizers, which can be used with almost any computer, music synthesizers tend to be computer-specific. So users wishing to get into music synthesis may want to find the music synthesis package first and then buy the computer that goes with it.

Talking with Your Computer

Forming human-like speech is very complex and involves a number of factors. Speech consists of volume (loudness), frequency (pitch), and timbre (vocal tone). Words are formed from phonemes, the smallest unit of speech.

Speaking into a microphone translates sound into electrical signals. These signals can be displayed on an oscilloscope as wave-

forms—a series of mountains and valleys which represent different combinations of frequency, volume, and timbre.

Text-to-speech algorithms (mathematical formulas) convert electrical signals (digital information) to analog sound. After digital-to-analog conversion, speech is jerky and mechanical so the synthesizer must be fine-tuned to approximate the human voice.

Commercially available synthesizers vary greatly in their ability to reproduce the human voice. Also, some synthesizers do not work well with all forms of text. For example, a blind person may wish to have the synthesizer voice all text that would normally be displayed on the screen or printer. Sometimes, words should be spelled to verify accuracy, or spoken one at a time, or in complete sentences. Not all synthesizers offer all of these options. Dumb synthesizers will speak all of the punctuation—they interpret each character verbally. Others, like the Echo, allow the user to select whether or not punctuation should be spoken.

Some synthesizers can be adjusted to sound like a woman's voice, or to imitate foreign pronunciation. The Voice Box, for instance, can be adjusted to speak with an Irish accent. In order to get some synthesizers to pronounce words accurately, they must be misspelled; for example, "scene" must be spelled "sen" before the Votrax Type 'N Talk will say it correctly. Others, such as the Voice Box, will allow the user to enter the correct spelling and the desired pronunciation separately.

Get a demonstration before buying a voice synthesizer, and make sure you can understand the documentation. All the features in the world won't help if you can't get the device to work.

Several reviews of voice synthesizers appear later in this chapter.

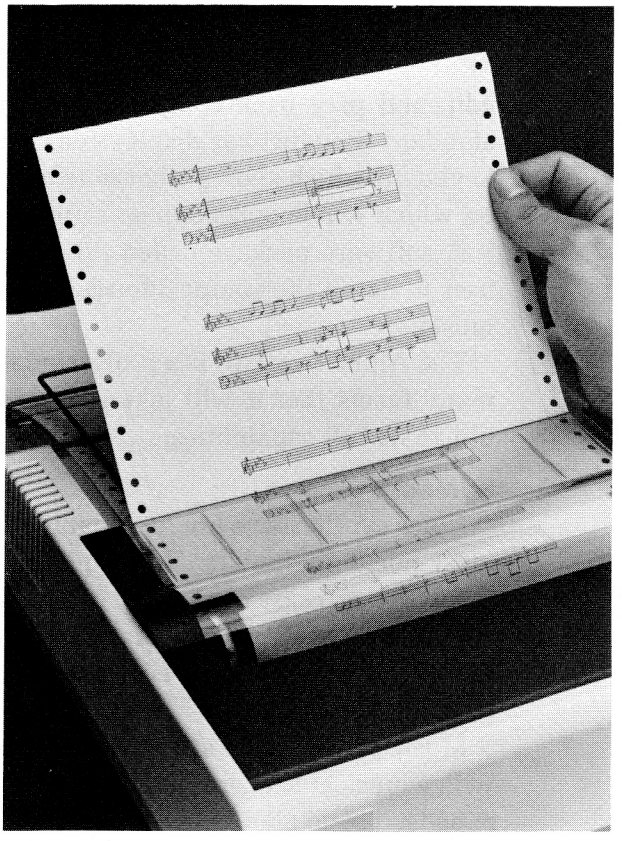
Music Synthesizers

Although anyone can write music with a music synthesizer, musicians will do it better, faster, and with less frustration. Many music-generation software packages are available for home computers. These programs allow the user to create sounds and music using the "voices" and speaker capabilities in the computer, television, and/or monitor. Music synthesizers are complex, professional-quality devices which work with sophisticated software to produce high-quality musical works. They carefully control timing sequences, frequency, and duration to produce melodies, chords, drum syncopation, and many other effects.

CompuMusic, made by the Roland Corporation, produces a unit compatible with Apple IIe, IBM, TRS-80 Model IV, Commodore 64, and NEC computers. This $600 hardware and software package gives a format for entering musical information in the form of numbers. Each of the eight channels is programmed separately. Six channels correspond to melody, bass, chords, etc. A drum channel has one output—gate time—which allows expression.

The CompuMusic system is like a musical word processor. A user

Syntauri 5-Octave Keyboard. Courtesy of Syntauri Corp.



Dot-Matrix Printed Sheet Music. Courtesy of Passport Designs

can edit any channel a measure at a time and hear it played back. It is ideal for a composer who wants to hear a piece one bar at a time. Pieces created on this synthesizer can be fed into larger, more sophisticated synthesizers. In essence, the computer acts as a complex voltage and clock controller for the synthesizer.

CompuMusic's manual is not very clear for the casual user, since it's written for the technician who understands music. The examples are good but rather short.

The Alpha Syntauri Synthesizer, from the Syntauri Corporation, costs $1800 for the Apple computer. Mountain Music provides three expansion boards which fit into the Apple slots. This provides sixteen programmable oscillators—two oscillators per voice (pitch and duration). Each voice can be programmed separately and overdubbed. The user can input information from a five-octave keyboard equipped with two foot pedals and phone jacks, allowing the user to enter note values by "playing" the piece on a keyboard instead of entering numeric values.

The Alpha Syntauri is so good it can produce chimes and gongs, which are very complex sounds. The unit allows the user to create,

edit, and play back compositions. The display screen shows the standard Syntauri bar display for creating sounds, a picture of the keyboard which shows what note is being played, and a piano staff on which whole notes appear in their proper place.

A software package called the Composer's Assistant allows the user to dump the composition to a matrix printer to produce sheet music.

The Alpha Syntauri is a professional-quality system which has so many facets that it will take many months of experimentation to utilize its full capabilities.

SUMMARY

Voice synthesizers are reasonably priced and readily available for most home computers. Voice quality varies considerably as does flexibility and ease of use. Try one out before buying. You should be able to find several brands at local computer stores. If not, check with a computer club to see if any of the members can demonstrate theirs to you.

Music synthesizers are recommended for the brave or for people with a musical background. Since music synthesizers still tend to be expensive, you should be certain that the unit performs the needed tasks. We found that local computer stores do not stock music synthesizers, so we had to find vendors through a local computer club.

Voice Synthesizers

VOICE BOX

The Alien Group
Atari Model: $170; Commodore Model: $129

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home - Good

FEATURES
Software: 2 disks supplied
Cable: Serial
Speaker
Headphone/external sound jack
Power Supply: Wall transformer type

"Teach me how to talk," the Voice Box said as the cartoon character mouthed the words in unison. I felt very strange and excited talking to this Robbie-the-Robot-like creature who appeared on my television screen.

"Hi, how are you?" This sounds like a bad imitation of Dracula, I thought, as the Voice Box translated text into intelligible and understandable speech.

The Voice Box comes with a demo program of commonly used words, which utilizes the 64 basic Votrax phoneme codes. The Voice Box can be taught to say anything with variations in inflection, speed, and pitch. For example, intonation can be changed as follows: I *love* you; *I* love you; I love *you*. The user can redefine many of the words in the pronouncing dictionary as well as create new ones. As the user makes changes, the Voice Box repeats the sounds, thus allowing fine-tuning before the sound is saved.

Program flexibility allows the user to change the "voice" characters easily and to define pronunciation for nonphonetic words. The main purpose is to create a pronouncing dictionary. Users can also change the mouth shape to correspond to the sounds.

The Voice Box can also sing: A demo program illustrates "A Bicycle Built for Two," sung with a distinct Irish accent. I had diffi-

culty making it sing on the Atari, however, due to some confusing key sequences. An additional software package, Comprehensive Music System (which I did not review), is available at extra cost; it has a library of songs with music accompaniment and an animated face. This package also turns the top two rows of the computer keyboard into a music synthesizer keyboard—allowing the user to write songs and to save them.

A separate game disk has good graphics and sound and was fun to play. However, I had to reboot the system each time I wanted to load a different game. Documentation for how to load and play the games is poor. The quality and number of these games won't, by themselves, justify buying the Voice Box.

As a programming utility, the Voice Box is a lot of fun. Documentation for "playing" with the utility is very good—a learn by doing approach—but needs more information on how to integrate Voice Box capabilities into other programs. The possibilities for educational programming are fascinating. However, if you aren't a programmer type, your interest may wane in a short time.

Voice Box plugs into the serial output on an Atari disk drive (final serial port) and into the user port (serial) on the Commodore 64. The unit is custom designed to interface with the individual computers so you must buy the correct model.

SUMMARY

The Voice Box is a voice synthesis device with program utility and entertainment demo disks. The versatility of the Voice Box allows the user to closely emulate human speech and patterns of mouth movement on the screen display. The software allows the user to save the vocabulary dictionary to disk (or tape) for future use. The documentation for using this information in other programs could be better. Nonprogrammers may in time become disinterested in this device.

ECHO SPEECH SYNTHESIZER

Street Electronics Corp.
ECHO GP and ECHO-PC: $199.95

PERFORMANCE RATING
Performance: Good
Documentation: Hacker - Fair; Novice - Poor
Ease of Use: Hacker - Fair; Novice - Poor
Usage: Home - Fair; Commercial - Poor

FEATURES
Four voice modes (female voice, optional)
400 language and pronunciation rules
Built-in speaker and volume control
Power Supply: Wall-mount transformer type
Interface: RS-232C serial
Baud Rate: 75 to 9600 (DIP-switch selectable)
Buffer: 1700+ characters
Dimensions: length 5.25 in. × width 3.75 in. × height 1.5 in.

The ECHO General Purpose (GP) and the ECHO-PC (IBM) units are stand-alone speech synthesizers with built-in speakers. The 1700-character-buffer allows the computer to send information to the synthesizer faster than the ECHO can speak. The ECHO's resident text-to-speech program gives the computer an unlimited vocabulary: 400 language and pronunciation rules let the synthesizer say virtually anything. Simple software control-character commands allow the user to control the rate of speech (regular or fast), the output mode (spoken and/or printed to the screen), the reading format (word-by-word, letter-by-letter, with or without spoken punctuation), the pitch (63 levels), and the volume (15 levels). The ECHO will also speak, as individual letters, words typed in all caps—for example, I-B-M.

ECHO's speech was difficult to understand because its pronunciation is peculiar. The documentation was inadequate for my computer system (Z-80 using MBASIC), so I never could get the phonemes to work. I did manage to change pitch, frequency, volume, and pronunciation by word or letter-by-letter—all worked well.

What documentation there is, is well written. However, many of my questions went unanswered, including some on technical inter-

facing. I couldn't get ECHO to speak "by merely sending it text," as the manual and sales literature suggest. The program example in the back of the manual didn't work with my computer and the documentation didn't tell me enough about the program. The BASIC tutorial programs are written only in idea form, and many novices will not be prepared to fill in the information. The documentation was better for using the unit with Heath, the Apple computers, Atari, COCO, and TRS-80.

SUMMARY

The ECHO synthesizer is a workable unit but its pronunciation is difficult to understand. Documentation is well written, but lacks many details that would help the novice take advantage of its many features. The Voice Box was much easier to program and easier to understand.

TYPE 'N TALK

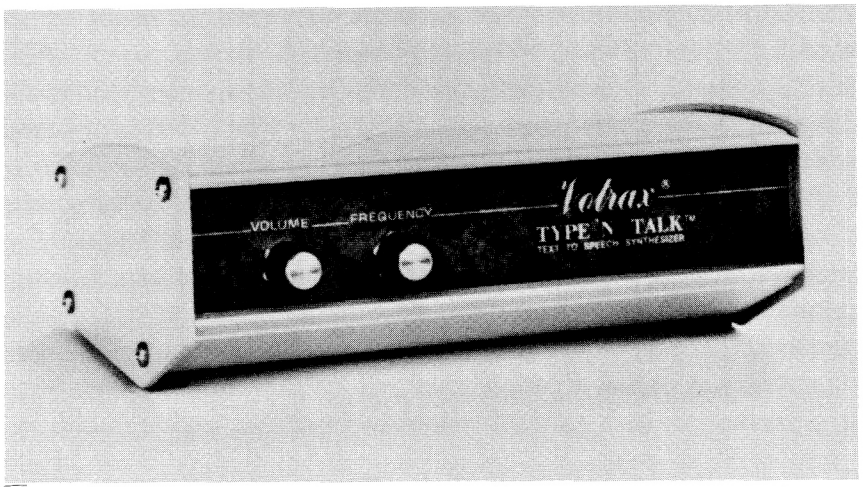
Votrax, Inc.
$249

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Commercial - Fair; Home - Excellent

FEATURES
Microprocessor-based text-to-speech algorithm
Audio amplifier
Baud Rate: Switch-selectable from 75 to 9600 bits per second
Data echo of ASCII characters
Interface: RS-232C serial
Buffer: 750 character (.75K)
Controls: Volume and frequency; Speaker jack for 8-ohm speaker
Dimensions: width 7.7 in. × depth 5.2 in. × height 3 in.
Weight: 2 lbs.

The Type 'N Talk voice synthesizer is easy to use: just plug it into the serial RS-232C port and go. The user types in a word and the synthesizer speaks it, using the pronunciation and phonetic rules stored in ROM (internal memory). Pronunciation can be refined by misspelling the word. For example, the word "scene" must be

Type 'N Talk. Courtesy of Votrax, Inc.



spelled "sen." Type 'N Talk doesn't have the capability of storing words with their pronunciations, as the Voice Box does. Nor can the intonation and length of vowel sounds be changed. The frequency of sound can be adjusted to give a deep or a high voice.

Statements may be typed using standard English. Type 'N Talk can also speak screen prompts, which might be overlooked in a cluttered visual presentation.

The unit is self-contained and easily interfaced to a computer, modem, or any RS-232C compatible serial device. It translates text independently of the host computer and stores up to 750 characters in the memory buffer. The echo feature relays data received by the device to the next unit or peripheral in daisy chain fashion. If more than four seconds elapse after a character in a text string is sent, the synthesizer translates and speaks the text in the input buffer. This timer function can be disabled with a software command.

Hackers may find the documentation adequate. However, novice users may have difficulty understanding the manual without some experimentation.

SUMMARY

The Type 'N Talk is a very popular speech synthesizer. Its speech is a bit difficult to understand unless the user alters spelling to match the phonetic pronunciation. The unit is relatively easy to install and use, and the documentation is adequate.

Auxiliary Speaker/Amplifier

THE COMPUTER SPEAKER

CSP
$29.95

PERFORMANCE RATING
Performance: Excellent
Documentation: Excellent
Ease of Use: Excellent
Usage: Home/Commercial - Excellent

FEATURES
Internal Speaker: High fidelity, 3 in.
Amplifier: 8-watt output
Input: RCA phono plug
Output: Auxiliary speaker (for extra speaker)
Controls: Power on/off; volume
Indicators: LED for power on/off
Power Supply: Wall transformer
Dimensions: length 8.5 in. × width 6 in. × height 2 in.
Weight: 2 lbs.

The IBM PC, IBM PCjr, Commodore 64, VIC-20, and other computers which support both monitor (video) and audio output, can now achieve quality sound. The Computer Speaker is a self-contained amplifier and three-inch speaker system which gives high-fidelity sound to computer users who dislike the output from their television or limited computer speakers. It's particularly valuable for people using monitors such as the Gorilla and Amdek Color II Plus, which have no audio output. The Computer Speaker operates with any computer, video tape recorder, or tape recorder which has audio output and an RCA phono plug.

Packaged in a sturdy beige and black metal case, the Computer Speaker may be attached to the side of the monitor or computer terminal. The auxiliary output phono jack allows the Computer Speaker's amplifier to drive another independent speaker for simulated stereo sound. This speaker worked very well in our tests, and brought life-like quality to computer-generated sound effects and music.

Chapter 7

Making Computing Easier

A number of personal computer peripherals don't conveniently fit into the chapter categories covered thus far. And yet, these devices help make computing trouble-free, fun, and productive.

Nothing is more aggravating than to have the computer suddenly lock-up or autoboot. Transient variations in utility line power can not only erase data stored in RAM, but can also damage delicate computer circuits and components. Power protection devices and auxiliary power back-up supplies provide protection against voltage spikes, interference, power brownouts, and blackouts. Power protection is covered in more detail later in this chapter.

Most computers must supervise sending data to printers and modems. The user must wait long periods for a printer to accept information and print it at 12 to 200 characters (bytes) per second. The computer is capable of sending this information to the peripheral at approximately 2000 characters per second (19,200 baud). At this rate, the operator doesn't have to stop computing to wait for slower peripherals to do their job. The buffer improves efficiency by accepting the data at high speed, storing the information in RAM chips until the peripheral is capable of accepting more, and delivering the data as the peripheral is able to use it. Provided the buffer can store the entire document or file, the computer can go on to other tasks.

Another set of peripherals allow the computer to control the external environment. With the proper software, clock, and controller the computer can turn on lamps, start the coffee pot, select a television program, water the lawn, and monitor for burglars. Although

computers are not yet true intelligent robots, this is highly suggestive of things to come.

This chapter discusses power protection, buffers, robots, and environmental controllers. Specific product reviews appear at the end of the chapter.

Power Protection

Overvoltage transient suppressors protect AC-powered equipment against voltage surges that exceed approximately 130 volts. They also protect equipment from high-frequency spikes and from AC line current interference (EMI-RFI filter). Any of these AC current phenomenon can cause the computer to become confused and lose data. If the current spike is high enough, it can even damage computer circuits.

These protector units plug into the normal AC wall socket to provide protected and fused outlets into which computer equipment is plugged. Various lights and buzzers indicate line current status. The protector may even have a master switch for turning all outlets on and off simultaneously. Computer systems function better if each device is plugged into a common circuit and powered up at the same time. For example, I plugged my printer and computer into different wall sockets. When I turned the printer on after powering up my computer, it printed a series of "@" signs across the entire platen. Plugging the printer and computer into the same power strip eliminated this problem.

Some users need more protection than just line filtering. Power back-up units provide both line filtering and auxiliary power for up to 30 minutes or more, depending on battery supply and the amount of current the computer draws. These units flash lights and buzz buzzers to alert the user that AC line power has dropped below acceptable voltage levels and that the battery back-up unit is providing computer power. This gives the user time to save important files, stop processing at a convenient point, or shut down equipment safely.

The rechargeable, sealed batteries usually last several years without maintenance. The auxiliary power supply should have a charging circuit which recharges the battery when AC current is restored.

Some power back-up units allow the user to plug the device into a car cigarette lighter socket. The computer receives the proper power

from the back-up unit which draws on the automobile battery. Such portability is a dream for traveling salespeople and free-lance writers.

Many auxiliary power supplies output square or rectangular electrical waves instead of sine waves. Find out if your computer and peripherals can tolerate and operate on this type of current. Some devices can be damaged by square and rectangular waves.

Check the wattage that your system draws. Most personal computers should be able to operate on 200 watts; however, 100 watts may be adequate and less expensive.

Buffers

As a writer, I've lusted for a printer buffer. Magazine and book editors demand typewriter-quality manuscripts. My C. Itoh (TEC) daisy wheel printer produces 25 characters per second or about one double-spaced page per minute. A 3000 word chapter (15 pages) takes ten to fifteen minutes to print. Since I don't have a tractor feed to keep my paper lined up, I must supervise printing—at least out of the corner of one eye. So I sit by the terminal waiting for the printer to release the computer so that I can write the cover letter and prepare the mailing label.

Now that I have a buffer, my life is changed. For instance, while I was preparing the manuscript for this book, I could print a chapter while entering the editing for the next chapter. When the printer finished Chapter 1, I was ready to send the edited Chapter 2 to it. Without a buffer, I wouldn't be able to edit Chapter 2 until Chapter 1 was completely printed. My buffer saved me many hours of frustration.

Buffers may also let the user duplicate printing. For example, you may want to print a letter and then another copy for your files. Pressing the COPY button duplicates the document and then sends it to the printer. You can also send more than one document to a buffer, provided it has enough memory to store them. If you send a series of letters, reports, and contracts to the buffer, it will send them to the printer one-by-one until the entire printing job is complete. All the while you can continue using the computer to prepare documents for printing and perform other operations.

Having a buffer is almost like having another computer. In fact, one of the buffers we reviewed, the ShuffleBuffer, can even perform

mail merges and other "computing" functions. Some buffers such as the Angel can also change the communication mode to support both serial and parallel peripherals. Even though the Angel may be connected to the computer's serial port, it can send information to both serial and parallel devices. This could make a computer more versatile by providing additional ports.

See the following section for reviews of several types of buffers.

Environmental Control

We all dream of sitting in our easy chairs and controlling the space around us. Someone left the bathroom light on—you press a button and the annoyance is taken care of. Company is coming in twenty minutes—you press a button and the coffee pot starts perking. While you're vacationing in Hawaii, the sprinkling system automatically senses the soil conditions and waters the lawn as required. These conveniences are not really far fetched. In fact, with a personal computer, proper software, sensors, and controllers, you can do all this right now.

HERO, the personal-computer robot from The Heath Company, can pick up a glass of wine and carry it to a waiting guest. HERO is 20 inches high, moves on three wheels, turns his head 350 degrees, and weighs 39 pounds. In kit form (for do-it-yourselfers only) HERO costs $1495, and assembled $2495.

Gladstone from Robot Adversary is an electronic chess game equipped with a robot arm to move the chess pieces. Gladstone even places captured pieces neatly on the side of the playing surface. If you get in a tough spot, you can turn on Gladstone's AUTO (automatic) mode and have the robot play for you until you're in the clear. Press the HINT key and Gladstone will help you solve the problem yourself. If you're lonesome, turn on Gladstone's voice synthesizer to hear squeals of glee and disgruntled pouts. For $1400 you can have a chess companion any time of day or night.

The BSR X10 home control console (reviewed at the end of this chapter) may be hooked to your computer to control up to 16 switches throughout your home. You can turn appliances and lights on and off under computer control, giving the appearance that you're home when you are really not. The console can also control heating and air-conditioning for efficient, cost-effective operation.

Nippon Telegraph and Telephone (NTT) and Electronic Commu-

nications Lab of Tokyo have developed a robot that turns book pages and reads a newspaper aloud. Tsuchiyama manufactures a robot which can put a disabled person into a bath—the electronic nurse may be next.

Smarthome, a $399 attachment for a microcomputer, can be connected to an infrared burglar alarm. When it detects movement or heat in the room, lights start flashing and appliances turn on and off to frighten the intruder.

The Energy Control System (ECS) from Technicom goes a step further. The 6 in. × 8 in. × 2 in. box lets you call home and control home appliances by way of a touch-tone phone miles away. (It is carried by Greybar Electric of St. Louis, Missouri.)

Before a computer or robot can do many of the "intelligent" things we might want, the technology will have to improve considerably. First, the robot must possess vast amounts of *factual knowledge,* which might be compared to textbook knowledge. However, the computer cannot perform "intelligent" acts with facts alone. It must also possess *heuristic knowledge,* which includes the networks of intuition, association, judgment, rules, pet theories, and inferences. Both heuristic *and* factual knowledge are needed for intelligent behavior. The third ingredient for artificial intelligence is *metaknowledge*—the ability to form strategies for problem-solving and an "awareness" of how to think. Artificial intelligence will permit robots to learn from experience. It will be possible to transfer information learned and stored in one robot's memory to that of another's in minutes. This capability will reduce on-the-job training and orientation.

It will be some time before personal robots are equipped with artificial intelligence. However, breakthroughs are occurring every day and significant developments can be looked for within the next five years. Consumer demand and competition will provide a truly remarkable array of robot features in the 1980s. Personal robots will help with tasks in homes and yards, improve safety and security, entertain and educate, supervise children and the elderly, perform strenuous and repetitive chores, and provide companionship.

The following reviews will tell you more about the peripherals that will make computing and your life easier.

Power Protectors

PUPS (PORTABLE UNINTERRUPTIBLE POWER SOURCE)

Bits Power Systems
$495

PERFORMANCE RATING
Performance: Excellent
Documentation: Good
Ease of Use: Good
Usage: Commercial/Home - Excellent

FEATURES
Output: 100 watts
Rechargeable gell-cell batteries
Cigarette lighter plug for 12-Volt system
3 standard grounded outlets
Controls: On/off switch
Indicators: 4 LED displays to indicate status
Dimensions: length 13.5 in. × width 9 in. × height 3 in.
Weight: 19 lbs.

The low profile of this power back-up device allows the user to place the computer or monitor on top of the unit. In contrast, most power back-up supplies are housed in cubical boxes that are more bulky to store. All of the controls, indicators, and electrical outlets are located on the front of the unit for easy access. The built-in handle also serves to prop the unit up at a convenient viewing angle.

The rechargeable gell-cell batteries provide 30 minutes of auxiliary power and have a life expectancy of three to four years. PUPS may be plugged into a cigarette lighter socket to provide portable power in a car, camper, or boat. It is compatible with either 115 or 230 V AC power sources. PUPS also protects the computer from interference and voltage spikes. A push button activates a four-LED-strip to indicate the seven operating states such as battery low, battery charging, and battery fully charged. Visual, audible, and remote alarms alert the user when power drops out.

PUPS may also be wired directly into the computer so that its on/off switch can turn the computer and peripherals on and off simultaneously.

SUMMARY

The PUPS power filter and power supply back-up are conveniently packaged in a low-profile case with a carrying handle, front-mounted controls, and outlets. At $495, this unit provides economical and effective line filtering and auxiliary power for up to thirty minutes. The ability to plug the unit into a cigarette lighter's 12-Volt power source gives the user true portability.

CIRCUIT OVERVOLTAGE TRANSIENT SUPPRESSOR

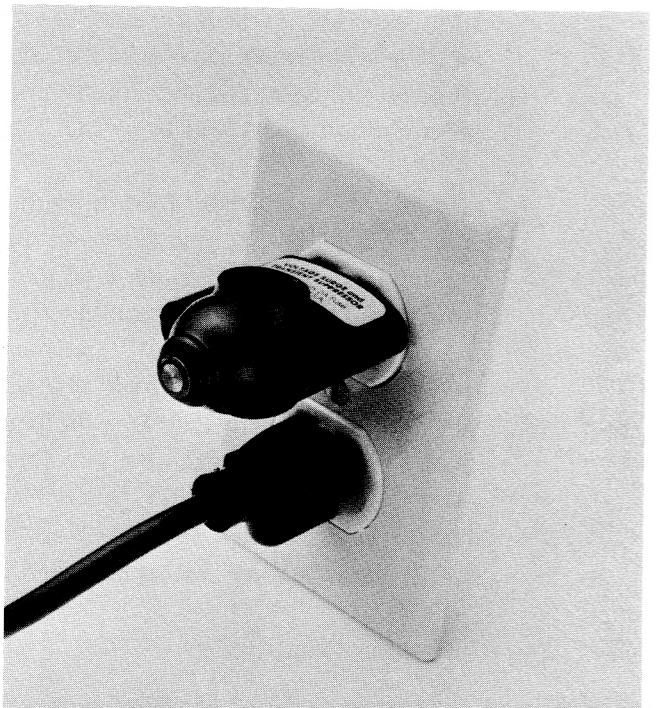
Cuesta Systems, Inc.
$29.95

PERFORMANCE RATING
Performance: Excellent
Documentation: None (sales literature only)
Ease of Use: Novice - Excellent
Usage: Commercial/Home - Good

FEATURES
15 to 20 amp breaker service
Clips overvoltage transients above 132 volts AC
Internal fuse
LED indicator

The Circuit Overvoltage Transient Suppressor is an economical device for protecting AC-powered equipment against voltage surges that exceed 132 volts AC. It also protects equipment from high-frequency spikes which occur anywhere over the full-input voltage waveform. This protection prevents phantom data errors and electrical equipment damage. The fuse interrupts the AC power in case of an equipment short circuit.

The user can easily install the Suppressor by inserting it into the AC wall socket on the breaker (circuit) to be protected. The best



The Circuit Overvoltage Transient Suppressor. Courtesy of Cuesta Systems, Inc.

way to protect a piece of equipment is to install the Suppressor into the socket adjacent to the one into which the equipment is plugged. If more sockets are needed, a power strip may be plugged in next to the Suppressor. The Suppressor protects all devices plugged into that circuit.

An amber lamp indicates that the Suppressor is operating normally in an active AC power line. A color shift to red or to green indicates nonsymmetric power, which should be checked by the utility company. If the lamp does not glow, the circuit is dead or the fuse is blown.

The fuse is easy to replace; it is, however, a special fuse and is not marked with an amperage rating. So the user must buy extra fuses from Cuesta. This seems to be an unnecessary inconvenience since a standard fuse would do fine. I did not try to blow the fuse.

No documentation comes with the Suppressor. No warranty terms are stated in the sales literature.

SUMMARY

The Suppressor does a good job of eliminating line noise, and at $29.95 is about half the price of similar units on the market.

CUESTA DATASAVER

Cuesta Systems, Inc.
$495 (200 watts); $350 (90 watts)

PERFORMANCE RATING
Performance: Unacceptable
Documentation: Poor
Ease of Use: Novice - Good; Hacker - Excellent
Usage - Poor

FEATURES
Auxiliary AC back-up (when voltage drops below 102V)
Voltage Output: 102 to 132rms
Internal sealed battery with automatic charger
External 12-V automobile battery, optional
Instant-alert alarm buzzer and indicator light
Dimensions: length 9 in. × width 6 in. × height 4 in.
Weight: 14 lbs.

The Cuesta Datasaver AC-Power Back-up is widely advertised in computer magazines. A review by Roger H. Edelson in the February 1984 issue of *Interface Age* indicates that the 200-watt model worked well with his computer system, employing a 5-MB hard disk, single 5¼-inch floppy disk drive, and built-in monitor. However, my experience was quite to the contrary.

When my Xerox 820 with a monitor and two 8-inch floppy disk drives went on the auxiliary power back-up system, not only did I lose all of my data but my memory chips were damaged also. The computer had run very reliably for many months prior to these test procedures. After the memory (RAM) was replaced, the computer worked fine once more.

Like Edelson's, when my computer went on back-up power, the disk drive motors sounded different—as if they were loading down. If I turned the system off and then back on under auxiliary back-up power, the fan motor and disk drive motors would not restart. These results demanded closer examination.

I attached a Model 2213 Tektronix oscilloscope to the Datasaver output signal and also tested the quality of the utility line signal. An amp probe revealed that the computer was drawing a 1.4 amp load at 177 V, well within the 200 watt rating. When the AC line was active, the 60-Hz sine wave from the Datasaver was identical to that coming directly off the utility power line (clean, with no discernible

spikes). Under load and with the AC power disconnected, the Cuesta put out a slow risetime square wave, approximately equal to 70 percent of the line voltage. This output roughly simulates the AC power line sine wave output. However, a large negative spike with a sharp risetime made the signal very noisy. When the unit was overloaded by 23 percent (257.4 watts), the oscillating signal power dropped, the noise spike (interference) increased, and the system produced a great deal of noise.

This power supply back-up system should only be used with a computer or device that has a good noise filter. Also, the equipment should be capable of operating with a square wave power input—not all computer devices can.

The unit itself is well designed, except that the on/off switch is inconveniently placed on the back panel. The unit could be operated better if the on/off switch were moved to the front panel. Fuses are provided for both input and output lines. Replacing the fuses is very difficult due to their placement in the unit; the average user couldn't service the fuses.

The internal battery is a sealed lead-acid gell-cell battery which does not emit caustic gases. The built-in charging system keeps both the internal and auxiliary batteries charged. Cuesta sells a 6-foot battery/cigarette lighter cable adapter which allows the user to operate the computer in a car, camper, or boat.

The green indicator light signals a normal AC power line condition. If the line voltage drops below 102 V, the power back-up unit cuts in within ten milliseconds, a buzzer sounds, and a red light flashes every five seconds. The internal battery can maintain current for five minutes at maximum rated output. If the user installs an auxiliary 12-V automobile battery, much more time can be had. The external battery must provide between 10.8 and 14 volts.

Jacks make installing the external battery easy. However, on the 200-watt model, if the user connects the battery cables backwards (reverses polarity), there is no protection for the inevitable serious circuit damage. The 90-watt model does offer this protection.

The reference manual seems to contain most of the information the user needs; however, it's a bit disorganized. For example, the caution about reversing the external battery cables appears on page seven. Since the battery could explode and cause injury and damage, we feel that this caution should appear at the latest on page five, under the heading Datasaver Installation.

The schematics do not specify part numbers or component values. Therefore, a technician or hacker could not easily repair the unit. The quality of the components is very high, the case is made of heavy aluminum, and the internal construction is of good quality.

The Datasaver has a 90-day warranty for parts and labor. The warranty is honored by the "original place of purchase." The battery warranty is void if the battery is allowed to fully discharge below 9.96 VDC. This is a reasonable requirement.

SUMMARY

The idea for the Cuesta power protection device is good. However, the power output to the computer during AC interruption is electrically noisy and may cause loss of information and damage to memory chips. The square wave output may not be compatible with some electronic devices. I recommend caution in buying this device since it would not operate my computer and damaged computer circuits.

MODEL C120 CLIPPER SURGE SUPPRESSOR

Dymarc Industries, Inc.
$59.95

PERFORMANCE RATING
Performance: Good
Documentation: Poor
Ease of Use: Good
Usage: Good

FEATURES
3 fully protected outlets
Audible signal
Fuse protected
Stops spikes of 6000 volts or more
5 nanosec. response time
Dimensions: 3.5 in. × 3.25 in. × 1.75 in.
Weight: 0.5 lbs.

The Clipper Surge Suppressor protects the line against surges and spikes of 6000 volts or more. The failsafe beeper and red LED let the user know when the unit is not operating properly. The circuitry stops live line spikes and ground circuit spikes. The unit is rated for both 230-volt and 110-volt AC outlets at 15 amps.

An orange rocker switch allows the user to select one or three of the receptacles; however, the documentation doesn't say how. The alarm system for detecting circuit malfunction is one of the best features of this device.

Plugging in the Clipper obliterates access to other wall receptacles. If the unit were slightly larger, it could accommodate four outlets.

SUMMARY

The Clipper appears to be a good surge protector. It has three outlets, a fuse, and an audible alarm to warn of circuit malfunction. A rocker switch allows the user to select one or three outlets. The only documentation available is the sales brochure.

THE LEMON, THE LIME, THE PEACH, AND THE ORANGE

Electronic Protection Devices, Inc.

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Fair; Hacker - Fair
Ease of Use: Excellent
Usage: Commercial or Home - Excellent

FEATURES

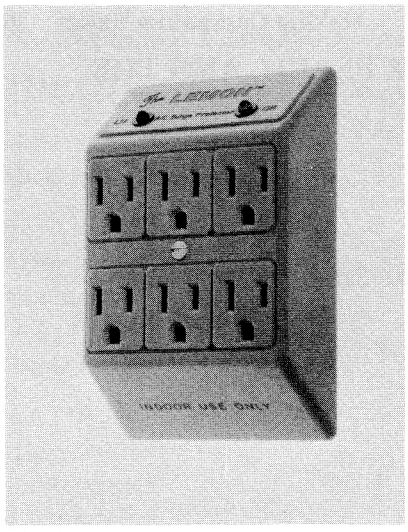
The LEMON - $59.95
AC surge protector
6 outlets
Wall mounted

The LIME - $89.50
AC surge protector
6 outlets
4.5-foot power cord
On/off switch

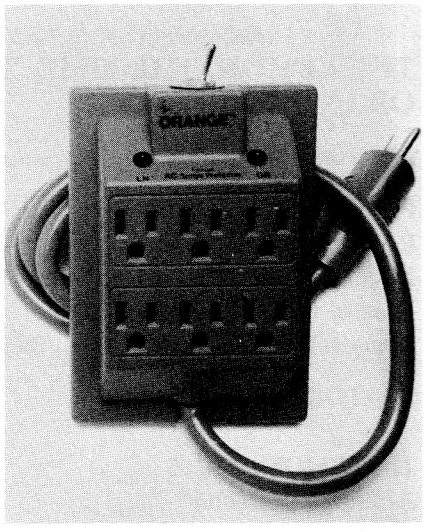
The PEACH - $97.50
AC surge protector
Line filter
3 outlets
Wall mounted

The ORANGE - $139.95
AC surge protector
Line filter
6 outlets
4.5-foot power cord
On/off switch

This family of AC line surge protectors and filters provides the personal computer user with a variety of products to meet varying needs. The solid state AC surge suppressors protect computer software and hardware from the danger of surges, spikes, and high-voltage transients. The suppressors with EMI-RFI filtering protection eliminate electrical "noise" from the line.



The LEMON. Courtesy of Electronic Protection Devices, Inc.



The ORANGE. Courtesy of Electronic Protection Devices, Inc.

Each unit is actually the color of its name, that is, the LEMON is yellow, the ORANGE is orange, etc. Each unit is also available in neutral beige.

Since the basic units and quality do not vary significantly, specifications for each unit will be spelled out and some general comments about performance, construction, and documentation will follow.

The LEMON is an AC surge protector which provides six outlets. The device is installed by plugging it into an existing three-wire grounded duplex receptacle (normal wall plug). First the wall plug cover is removed by unscrewing the center screw. The LEMON is plugged into the socket and screwed into the cover's place. If the user does not want permanent installation, the LEMON may be plugged into the socket with the original cover left in place. The LEMON is designed for a maximum 15 amp load.

The LIME is basically the same unit as the LEMON, except that it has a 4.5-foot cord to plug into a three-wire grounded outlet. The equipment to be protected is then plugged into any of the six outlets. An on/off switch provides an easy way to simultaneously turn the line current on and off to the computer and peripherals.

The PEACH may be inserted in a wall socket in the same manner as the LEMON. It will accept up to three three-pronged plugs with a total load under 15 amps (1875 watts). The PEACH not only protects

against AC surges but also filters the AC line current for EMI and RFI noise (electromechanical interference and radio frequency interference).

The ORANGE is basically the same unit as the PEACH, except that it has a 4.5-foot cord attached to plug into a three-wire grounded outlet. The equipment to be protected is then plugged into any of the six three-pronged outlets. An on/off switch provides an easy way to simultaneously turn the line current on and off to the computer and peripherals. The ORANGE provides both surge and EMI/RFI filtering protection.

EPD warranties its surge protectors for five years from the date of delivery. For an additional dollar, the user may purchase an insurance policy from Lloyds of London. This policy pays up to $2500 to repair or replace equipment that these products did not adequately protect. The risk to Lloyds of London is minimal since these units are constructed from high-quality components and designed to "take it."

For example, inside the ORANGE we found a choke and MOV on each of the six outlets—this is really overkill since one choke and MOV would protect the entire six outlets. We also found an MOV on the AC input line. This device should be capable of filtering any and all spikes short of a direct strike of lightning!

The switch on the ORANGE and LIME is very useful. However, we recommend mounting the unit on the wall since an accidental kick could trip the lever and interrupt (or apply) power at an undesirable moment. These units can also be easily mounted to the wall with a bracket supplied on the unit. The power cord to the ORANGE and LIME is very heavy duty.

The manual is brief but it does tell the user most everything needed. The installation procedures caution the user about exposed, live electrical wires when the cover plate to the wall box is opened. However, the manual does not suggest turning the power off. It is possible to touch hot wires with the screwdriver and get a shock, so we recommend turning the AC current off before permanent installation of the LEMON and PEACH.

SUMMARY

The Electronic Protection Devices, Inc., family of surge protection and filter devices is an excellent series of products. The design and

construction are very good, in fact better than required. The Lloyds of London insurance is a bargain, although we doubt that anyone ever needs to file a claim if they use these devices properly. Prices are competitive, although we feel that prices for most power protection devices are higher than they should be.

THE GRIZZLY 200-WATT UNINTERRUPTIBLE POWER SUPPLY

Electronic Protection Devices, Inc.
$895 (Also available in 500 and 1000 watts)

PERFORMANCE
Performance: Excellent
Documentation: Poor
Ease of Use: Good
Usage: Commercial - Excellent

FEATURES
Power Output: 200 watts at 120 volts
Surge protector
Noise filter
Receptacles: 2 UPS/2 AC
Waveform: Stepwave equivalent to true RMS value of sine wave (500/1000-W pure sine wave)
Batteries: Lead-calcium gell cells
Alarm: Buzzer and LED
LEDS: Green = AC on; Red = battery on
Dimensions: length 14.5 in. × width 9.25 in. × height 6 in.
Weight: 35 lbs.

The 200-watt Grizzly Uninterruptible Power System provides up to 20 minutes of power back-up protection at full load. Two of the four outlets on the unit provide back-up power. The other two AC outlets provide surge-protected current. The documentation doesn't say if the Grizzly filters these outlets. The green LED indicates that the surge protection is working. When the power back-up is activated, the red LED blinks every five seconds. During the last two minutes of battery operation, the red LED blinks once per second. Recharging the battery takes approximately five hours.

Some computer systems will not work properly with a step waveform (square wave). Consult your computer manual or dealer for specifications.

The manufacturer warranties the unit for one year and provides a lifetime limited warranty against damage to equipment through Lloyds of London.

SUMMARY

The Grizzly Uninterruptible Power Supply provides utility line filtering and surge protection as well as back-up power. The price seems a bit higher than equivalent units; however, the equipment warranty is an attractive option.

Buffers

MICROSPOOLER

Consolink Corp.
Parallel to Parallel: 16, 32, 64K - $219, $249, $299; Parallel to Serial: 16, 32, 64K - $249, $279, $329; Serial to Parallel: 16K, 32K, 64K - $249, $279, $329; Serial to Serial: 16K, 32K, 64K - $259, $289, $339; Cables: 5 in. parallel using Centronics 36-pin - $30.00

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Good; Hacker - Excellent
Ease of Use: Excellent
Usage: Excellent

FEATURES
Controls: Reset push button; Copy/Pause push button (up to 99 copies); Self-test push button; Power switch (rear panel)
Indicators: LED digital display of text in buffer (Kbytes); LED digital display of number of copies to be printed
Main Processor: 8048 or 8748
Clock Frequency: 4.9 MHz
Internal Memory: 16K standard RAM expandable to 32 or 64K
Data Rates: 50 to 19,200 bits per second
Connectors: Input - DB-255S receptacle; Output - DB-25P plug
Interface: Parallel - Centronics compatible; Serial - RS-232C
Dimensions: height 16 in. × width 2.5 in. × depth 8.3 in.
Weight: 3 lbs.

The MicroSpooler buffer interface keeps the printer busy while the user continues to use the computer. MicroSpooler receives information at the rate of up to 5800 characters per second (5800 bytes/sec.). If the user wants multiple copies, a push button signals the spooler to print up to 99 duplicates. The digital status readout tells the user how many copies remain to be printed. A pause button stops and restarts output. The pause instruction for single-sheet feeding applications allows the printer to stop and start as needed. A reset button empties the buffer of unwanted data. Since two buttons control all of the buffer's functions, the user must learn a series of button-pushing sequences, which could initially be confusing.

Four model choices allow the user to configure the buffer for

The MicroSpooler. Courtesy of Consolink Corp.

many interfacing needs: parallel computer to serial printer, parallel computer to parallel printer, serial computer to parallel printer, and serial computer to serial printer. For example, I have a PCjr with a serial output and a Okidata Microline 92 parallel printer. To get a parallel printer port for my PCjr, I'd have to spend about $150. With the MicroSpooler, I get serial to parallel interfacing plus a 64K buffer for only $339, or a 16K buffer for only $249.

The 23-page manual gives excellent instructions for installation and operation. Important interfacing information helps adapt the buffer to specific equipment.

I tested the serial-in/parallel-out 64K model. It worked so well that I bought it. I have one complaint, though: the parallel cable connector on the chassis is male. Since most manufacturers use female chassis connectors, standard cables have male connectors on each end. If the user doesn't buy Consolink's cables, then he or she will have to find or make some gender changers—I almost couldn't find the right connectors.

SUMMARY

The MicroSpooler is an excellent printer buffer which also allows the user to change interfacing from serial to parallel or parallel to se-

rial, depending on the model selected. The buffer operated perfectly, was easy to control, and took up little desk space due to its vertical design. The documentation is good. I suggest that the user buy the parallel output cable from Consolink since they use a Centronics male chassis connector where most manufacturers use the female version.

SHUFFLEBUFFER PARALLEL/SERIAL RANDOM ACCESS PRINTING BUFFER

Interactive Structures, Inc.
SB-32K: $299; SB-64K: $349; SB-128K: $445

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Good; Hacker - Excellent
Ease of Use: Novice - Fair; Hacker - Excellent
Usage: Commercial - Excellent

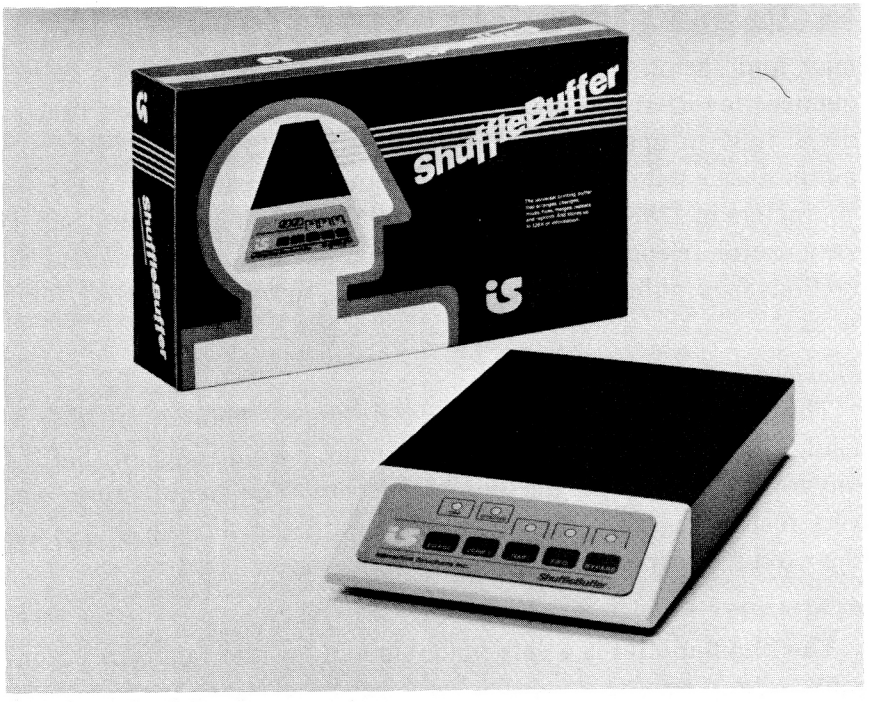
FEATURES
Computer Compatibility: RS-232C serial and Centronics parallel
Printer Compatibility: RS-232C serial and Centronics parallel
Cables: 2 cables, specified for computer/printer
Power Supply: AC wall-adapter with 6-foot cord
Controls: Mode touch switches—RAP, FIFO, and BYPASS; Control touch switches - VERIFY and ERASE
Indicators: LEDS - RAP, FIFO, BYPASS, VERIFY, ERASE
Memory: 32, 64, 128K (user expandable in 8K increments)
Dimensions: depth 12 in. × width 6.5 in. × height 1.7 in.

The ShuffleBuffer is the "buffer with a brain." Not only does it store and manage data transfer between computer and printer, but automatically combines text and generates personalized form letters (see RAP, below). The ShuffleBuffer will connect any personal computer with any printer. The buffer can accept data in either parallel or serial form and can send data to either serial or parallel printers.

Three Operating Modes

FIFO—In the simple First-In-First-Out mode, the ShuffleBuffer resembles other buffers on the market. Any beginner can use the buffer in this mode. The ERASE/VERIFY switches erase the data stored in memory and reset the buffer for another task. The user can print multiple copies of the same document or stop printing to enter the BYPASS mode.

BYPASS—If the user wants to stop printing a long document to do another job, he can press the FIFO/VERIFY keys to put the buffer into BYPASS mode. In essence this takes the buffer out of the printing circuit so that data can be sent directly from the computer



The ShuffleBuffer. Courtesy of Interactive Structures, Inc.

to the printer. Once the interrupting task is complete, the FIFO/VERIFY keys are pressed and the original printing job resumes where it left off.

RAP—Random Access Printing is a very unique feature. It allows the user to store separate text and graphics files into "buckets" or addressable areas of the buffer's memory. With a series of two-letter codes, the user can tell the buffer to print these buckets in any order. For example, the user may wish to do a mail merge between a personalized letter and a mailing list, or combine graphs from a graphics program into a word processing text file, or combine a number of paragraphs into a contract. The ShuffleBuffer will do all of these and more without immediate computer control. The manual provides many examples and describes in precise detail how to use the twenty or so commands used with RAP. The computer novice may be overwhelmed with these features and procedures; but an experienced word processing secretary will find that the ShuffleBuffer provides great flexibility and efficiency.

Excellent Documentation

The documentation is excellent. It shows all of the options and gives many examples. Due to the amount of information, a novice

may find the manual difficult to absorb. Learning the code sequences for RAP is a bit complicated. The manual tells in precise detail how to upgrade the memory by installing chips. Since the buffer uses a data compression technique it can store up to 131,072 characters in 128K of memory. The HINTS section near the back is very useful, friendly, and clear. The manual also gives excellent directions for troubleshooting the hardware, software, and RAP functions.

Flawless Operation

The ShuffleBuffer worked flawlessly once I figured out how to hook it to my computer and to my printer. I would suggest that the buyer have a dealer set the unit up correctly. The manufacturer was very responsive to my questions, and I appreciated being able to use their toll-free service number.

SUMMARY

The ShuffleBuffer is a very valuable tool for interfacing any computer to any printer. It works very well in all three modes: FIFO, BYPASS, and RAP. The Random Access Printing mode is unique to this device. RAP allows the buffer to store individual files into separate "buckets" (addressable memory areas) and merge them under software command to create and print a document. The procedures are well defined in the manual; however, the numerous instructions may overwhelm a novice. The hardware hook-up is rather complex and should be performed by a dealer.

SPOOL-Z-Q BUFFER

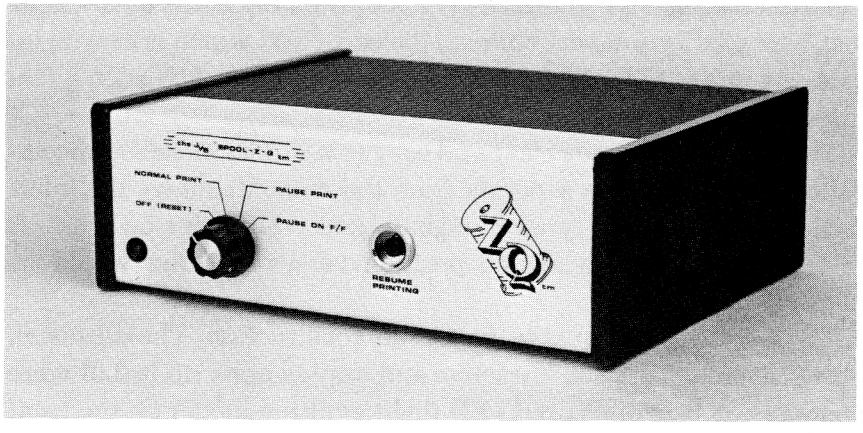
JVB Electronics
32K without cable: $219; 64K without cable: $249; 128K without cable: $309; Centronics parallel cable: $27

PERFORMANCE RATING
Performance: Good
Documentation: Novice - Fair; Hacker/Programmer - Good
Ease of Use: Novice - Good; Hacker/Programmer - Excellent

FEATURES
Interface: Centronics parallel; S-100
Cables: 4-foot, 36-conductor flat (ribbon) cable
Power Supply: Stand-alone transformer
Transmission Rate: Up to 2000 characters per second
Copy- and single-sheet feed capabilities; Plug-in memory expansion by user

The Spool-Z-Q is a dandy tool to use with slow printers. The buffer accepts the information from the computer, stores it, and sends it to the printer at the rate that the printer produces hard copy. Providing that text is smaller than buffer memory capacity, the buffer frees the computer to perform other operations. If you want several copies of a document, you can duplicate it with the push of a button. Several documents can be loaded into the buffer and be printed consecutively. For example, I could send a cover letter, the document, and my resume one after the other without wait-

Spool-Z-Q Buffer. Courtesy of JVB Electronics



ing for the printer to finish each task. The Z-Q took care of printing for me.

In case you need to adjust the paper or to answer the telephone, turn the switch on the front to PAUSE PRINT. You can resume printing by returning the switch to NORMAL PRINT and pushing the button called RESUME PRINTING. Sound simple? It is. (I didn't even read the manual to figure this out.)

If you make a printing mistake, turn the dial to OFF (RESET). At this point the printer stops (once the printer's internal buffer runs out). To clear the Z-Q buffer, reach behind the unit and feel between the cables for the RESET button. Push it several times to clear all data from the buffer. Then return the knob to NORMAL PRINT and resend the information to the buffer. For some reason, when I restarted the printer, I would occasionally get a few characters of print which had not been cleared from the buffer. Perhaps one time in ten, I had to repeat the clearing process, reset the paper and begin printing on a clean sheet. This was mildly annoying, but the benefits of the buffer far outweigh the inconvenience.

The buffer is capable of printing in a single-sheet feed mode. Place the knob in the PAUSE PRINT position and embed in the text a FORM FEED CHARACTER to signal when printing is to stop. Although the buffer works independently of software, the software must be able to send form-feed character code to activate the single-sheet feed feature.

The instructions for making duplicate copies could be improved. Several steps are required to duplicate text—one of which requires pushing the buffer CLEAR button on the back of the unit. Not only is reaching to the back somewhat inconvenient, but if the knob on the front isn't set to PAUSE ON F/F (FORM/FEED), the data will be lost. Many buffers have a button, labeled COPY, which is easy to locate and understand. This buffer would be improved by such a feature.

The documentation is clear and easy to use. The interface specification sheet (which is separate from the manual) shows the interface connections, the types of signals, and which pins do what. A few charts to explain switch position versus function would be helpful.

The Z-Q uses top-quality parts and construction. The all metal, vinyl-covered chassis is attractive and easy to open (to install more memory). A brightly lit red LED (light emitting diode) on the front

indicates when the power is on. The primary control switch is a real knob which clicks as it twists to each setting. Such positive control and feedback is reassuring among so many membrane switches which give as much feedback as pressing a styrofoam egg carton.

JVB Electronics uses quality switches, push buttons, boards, and connectors throughout. The unit should prove to be both durable and reliable. The sockets for expanding memory are already installed. Clear instructions explain how the user can add memory chips (in sets of three 4164 chips). Since the manufacturers use a data compression technique, only six chips are required to store 64,000 (64K) characters, instead of the usual eight chips, thus saving themselves and the user money.

SUMMARY

The Spool-Z-Q Buffer is a very useful tool. In general, the buffer is easy to use, except that the CLEAR button is somewhat inconveniently placed on the back of the case. The unit is constructed from quality parts and should prove to be durable and reliable. At $219 for a 32K buffer, this is an excellent buy.

ANGEL INTELLIGENT BUFFER

Ligo Research, Inc.
$295

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Good; Hacker - Excellent
Ease of Use: Novice - Good; Hacker - Excellent
Usage: Home/Commercial - Excellent

FEATURES
Computer Compatibility: RS-232C serial and Centronics parallel
Printer Compatibility: RS-232C serial and Centronics parallel
Cables: Serial to parallel, requires one special cable; Parallel to parallel, requires two special cables
Power Supply: AC wall-adapter
Controls: 8 membrane switches; 3 eight-position DIP switches
Indicators: LEDS - buffer status, page numbers, buffer size, control signals
Memory: 64K (with data compression, 128K)
Functions: Pause, hold, copy, multiple copy, page skip, page reprint, clear, reset, page pause, space compression, hex-dump, buffer status, readout, self-test
Dimensions: depth 7.5 in. × width 5 in. × height 1.5 in.

The Angel Intelligent Buffer not only stores and manages data transfer between computer and printer, but also allows almost any computer to connect to almost any printer. The buffer can accept data in either parallel or serial form, and send data to either serial or parallel printers.

The Angel Buffer. Courtesy of Ligo Research, Inc.

The eight-key membrane switch bank allows the user to clear the buffer, make multiple or continuous copies, examine how much memory is occupied, skip pages, pause printing, stop printing at the end of each page, and stop receiving data from the computer. By pressing combinations of these switches the user can achieve up to twenty (or more) different functions. For example, if the paper jams during printing, the operator may reset the printer and press PAGE REPRINT to have the printing resumed at the beginning of the page. One switch combination causes the Angel to enter an infinite copy loop.

The spiral-bound manual is complete and well organized. Although it's written in a comprehensible form, the novice may have difficulty understanding and remembering so many functions. The manual describes and illustrates interfacing the buffer with many different computer and printer combinations. However, the novice may wish to have the dealer set up the computer-buffer-printer system. Ligo Research provides a toll-free service number, and its representatives were very helpful to me even though they were not aware I was reviewing the buffer for publication.

The user reference card is quite well done and provides quick access to frequently used information. Hackers will appreciate the complex schematics with part numbers. The self-test provides a hex and ASCII dump of memory so you can see what's coming out of the port.

The buffer should be installed below eye level, since the membrane keyboard and LED displays are on top of the unit.

SUMMARY

The Angel Intelligent Buffer is a very valuable tool for interfacing almost any computer to almost any printer. As a buffer it works well in every mode. The procedures are well defined in the manual, although the numerous instructions may be confusing to a novice. The hardware hook-up is rather complex and should be performed by a dealer.

MICROBUFFER

Practical Peripherals, Inc.
MBIS - 64K (Serial): $349; MBIP - 64K (Parallel): $349

PERFORMANCE RATING
Performance: Excellent
Documentation: Novice - Fair; Hacker - Good
Ease of Use: Excellent
Usage: Home/Commercial - Excellent

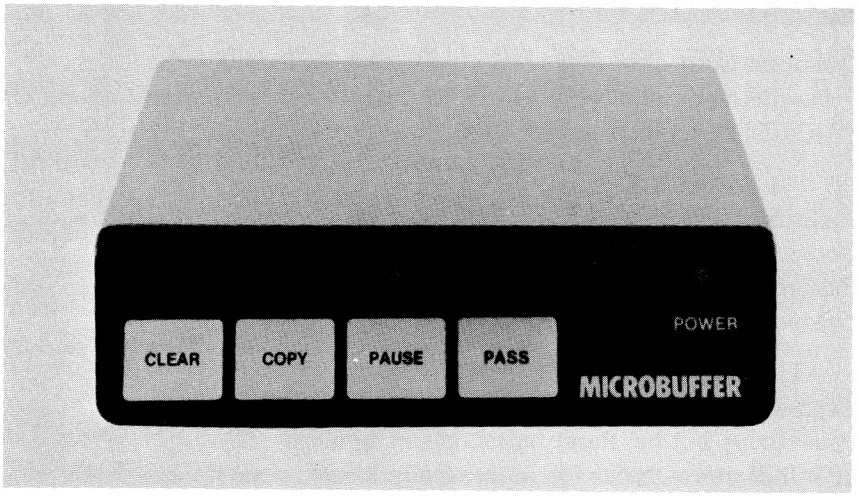
FEATURES
Interface: RS-232C serial or Centronics parallel
Transmission Rates: 75, 150, 300, 600, 1200, 2400, 4800, 9600, and 19,200 baud
Automatic multiple copy generation
Memory: 32K and 64K standard; upgradable to 256K
Dimensions: 5.5 in. × 8 in. × 2 in.
Weight: 1.5 lbs. for 256K unit
Cable: 4-foot, for connection to printer

The MICROBUFFER is a very well made and easily operated printer buffer. The model tested was the 64K serial version. Practical Peripherals uses high-quality components in a durable light-weight box. Membrane switches on the front are labled CLEAR, COPY, PAUSE, and PASS. A power-on light indicates that the buffer is turned on.

The CLEAR mode stops printing and places the buffer in a standby-to-clear mode. The COPY mode allows the user to duplicate a document up to 255 times. Additional data may be sent to the buffer during the copy procedure. The PAUSE mode stops printing. During pause, the buffer can receive additional data. PASS allows the data to bypass the buffer and go directly from the computer to the printer or modem.

Membrane switches (touch-sensitive controls) on the front do not give tactile feedback to the user, so that knowing whether the unit has received the command is uncertain. The switches work fine; however, while pushing the switches, the user must grasp the buffer firmly to prevent it from sliding around. The switch indicator lamps are very dim and are difficult to see in a brightly lit office.

The buffer may receive information in two directions. Thus, if it's connected to a modem, outgoing data may be buffered from the



The MICROBUFFER. Courtesy of Practical Peripherals, Inc.

computer to the modem and received data may be passed directly (unbuffered) from the modem to the computer.

Jumpers and DIP switches inside the modem can be used to configure the unit to the system. The instructions are clear and specific for these procedures. Complete novices may want the dealer to set up the buffer for the computer system.

Three pages in the back of the manual clearly tell how the user can install extra memory.

The five-year warranty on parts and labor is exceptionally long. The unit is warrantied by the retailer or factory.

SUMMARY

The MICROBUFFER is a very nice buffer, which is easily expanded up to 256K. The automatic copy feature is very convenient. The only improvement I could see making would be better feedback when a button is pushed and brighter indicator lights on the front panel. Otherwise, this is an excellent device.

MICROFAZER PRINTER BUFFER

Quadram Corp.
Parallel-to-parallel with 64K: $299 (includes cable); Serial-to-parallel/parallel-to-serial with 64K: $330

PERFORMANCE RATING
Performance: Excellent
Documentation: Hacker - Good; Novice - Fair
Ease of Use: Excellent
Usage: Home/Commercial - Excellent

FEATURES
Expandable from 8K to 64K
Pause/copy button; Reset button clears memory
LED Indicators: Buffer full, pause/copy, ready, error status
Power Supply: External transformer; Hard wire into Epson printer
Metal case
Dimensions: 3.6 in × 7.1 in. × 1 in.

The Microfazer is an excellent printer buffer with expansion capabilities. The model I reviewed was a snap-on unit which attaches to the back of the Epson printer. Although Quadram advertises this buffer as a univeral buffer, the manual refers specifically to operation with the Epson MX printer. The eleven-page manual may be a bit confusing to a novice. Illustrations show how to add memory chips (which cost $10 per 8K) and how to solder the buffer into

The Microfazer. Courtesy of Quadram Corp.

the Epson printer power supply. However, soldering and installation is not explained well enough for the novice. A troubleshooting chart gives good guidance for solving problems.

Operating the buffer is simple. The reset button clears memory; the pause button stops and resumes printing; and the copy button duplicates the printing process for additional copies. LEDs indicate the current status of the buffer.

The buffer can receive up to 4000 characters of data per second and comes in several data transmission configurations. Microfazer comes in parallel-to-parallel, parallel-to-serial, and serial-to-parallel modes. This allows the user to interface a parallel output computer with a serial device and vice versa.

SUMMARY

Microfazer is an excellent printer buffer with expansion capabilities. The documentation could be better for the novice. The buffer is easy to operate and works well. Several data transmission modes are available for converting parallel to serial and vice versa.

Environmental Control

BSR SYSTEM X-10 ENVIRONMENTAL CONTROLLER

BSR (USA) Ltd.
Ultrasonic Command Console UC 301: $49.99; Lamp Module: $22.50; Appliance Module: $22.50

PERFORMANCE RATING
Performance: Excellent
Documentation: Good
Ease of Use: Good
Usage: Home/Commercial - Excellent

FEATURES
Controls 16 lights and appliances
Hinged keyboard cover
120 AC volts
Special Features: On, off, dim, bright, all lights on, all units off
Module: Lamp module rated up to 300 watts; Wall-switch module rated up to 500 watts
Dimensions: 4.75 in. × 3.5 in. × 2.5 in.

The BSR controller may be used without a computer to control appliances and lights throughout a house. Each of the sixteen buttons corresponds to up to sixteen appliance modules or to special switches installed in the usual home 120-V wiring system. The modules are plugged into an ordinary 120-V wall socket and the appliance is plugged into the module. By selecting the module and sending commands to it via the controller, the user can dim and brighten lamps, turn on appliances, and operate burglar alarm equipment.

In conjunction with a computer, the user can control these operations automatically or at preset times. The computer must be equipped with a clock, computer interface, and software that is capable of communicating with the BSR controller unit. The computer-controlled environment is futuristic, and yet completely practical with an inexpensive computer and this unit. The user can adjust the heating and cooling, turn lights on in his absence, water the lawn while on vacation, start the coffee pot before rising, and dim the lights after midnight.

The handicapped user can operate the BSR controller without

getting out of bed. Severely handicapped quadriplegics may use the controller/computer combination by simply sipping and puffing into a tube. A sip on the special pneumatic switch moves the cursor on the computer screen to the menu choice. A puff on the switch selects the item from the menu and triggers the BSR controller to activate the radio, TV, or lamp switch. In this way the handicapped person gains some control over his or her environment. Sip and puff switches and designs are readily available from rehabilitation centers around the country.

Free pneumatic sip and puff switches and schematics are available from the Handicapped Users' Group (HUG) of the Tulsa Computer Society, P.O. Box 906015, Tulsa, OK 74112. This group of volunteers also provides sip and puff public domain software for communications, games, education, and other applications.

This unit works reliably over a long period of time, according to the Rehabilitation Engineering Department of the Tulsa Rehabilitation Center at Hillcrest Hospital in Tulsa, Oklahoma.

SUMMARY

The BSR System X-10 provides an excellent computer peripheral for controlling up to sixteen lights and appliances in one home or office. To operate the controller, the computer needs a clock, interface, and software.

PERIPHERAL EVALUATION FORMS

Date_____

PRINTER/PLOTTER EVALUATION FORM

BRAND _____ MODEL _____ PRICE _____

Performance: Excellent Good Fair Poor Unacceptable

Documentation: Excellent Good Fair Poor Unacceptable

Ease of Use: Excellent Good Fair Poor Unacceptable

Usage: Commercial/Home: Excellent Good Fair Poor Unacceptable

MFG. _____ DEALER _____

ADDRESS _____ ADDRESS _____

CITY_____ ST_____ ZIP_____ CITY_____ ST_____ ZIP_____

PHONE _____ PHONE _____

1. Dot Matrix / Daisy Wheel / Thimble / Color / Plotter
2. Serial/Parallel/Other_____ Baud_____ Buffer____
3. Size: Depth _____ Width _____ Height _____ Weight _____
4. Appearance _____ Noise Level _____
5. Software/Hardware Requirements _____
6. Print Speed_____ Pitch_____ Graphics _____

   Print Styles_____ Ribbon_____

   Bidir._____ Logic Seeking_____ Char. Sets_____

   Underline___ Double Strike___ Super/Subscript___ Descenders___

   Graphics Features _____

   Print Density_____ Print Quality_____

7. Paper Handling: Fan-fold / Single Sheets / Pin, Tractor Feed

   Paper Size(s)_____ Column Widths_____

   Multiple Copies_____ Front / Back / Bottom Feed

8. Indicators/Alarms/Controls _____
9. Ease of Use_____
10. Ease of Installation/Adjustment_____
11. Operating Characteristics_____

    _____

    _____

12. Special Features_____

    _____

    _____

13. Documentation_____

    _____

14. Tech Manuals_____
15. Warranty_____ Service_____ 800#_____
16. Special Requirements _____
17. Options/Prices _____
18. Comments:

Date_____

MONITOR/TERMINAL EVALUATION FORM

BRAND _____ MODEL _____ PRICE _____

Performance: Excellent Good Fair Poor Unacceptable
Documentation: Excellent Good Fair Poor Unacceptable
Ease of Use: Excellent Good Fair Poor Unacceptable
Usage: Commercial/Home: Excellent Good Fair Poor Unacceptable

MFG. _____ DEALER _____
ADDRESS _____ ADDRESS _____
CITY_____ ST_____ ZIP_____ CITY_____ ST_____ ZIP_____
PHONE _____ PHONE _____

1. Monochrome (Tint) ___ Color-TV/ Composite / RGB ; Terminal___
2. Compatible With: _____
3. Size: Depth _____ Width _____ Height _____ Weight _____
4. Appearance _____ Detach. Keyboard _____
5. Screen: Diagonal Size_____ Antiglare_____ Columns_____ Rows_____
6. Print/Graphics Characteristics _____

   _____
7. Picture Resolution_____
8. Color/Sound_____
9. Indicators/Alarms/Controls_____

   _____
10. Ease of Use_____
11. Ease of Installation/Adjustment_____
12. Operating Characteristics_____

    _____
13. Special Features_____

    _____

    _____

14. Documentation_____

_____

15. Tech Manuals_____

16. Warranty_____ Service_____ 800#_____

17. Special Requirements_____

18. Comments:

Date_____

MODEM EVALUATION FORM

BRAND _____ MODEL _____ PRICE _____

Performance: Excellent Good Fair Poor Unacceptable

Documentation: Excellent Good Fair Poor Unacceptable

Ease of Use: Excellent Good Fair Poor Unacceptable

Usage: Commercial/Home: Excellent Good Fair Poor Unacceptable

MFG. _____ DEALER _____

ADDRESS _____ ADDRESS _____

CITY_____ ST_____ ZIP_____ CITY_____ ST_____ ZIP_____

PHONE _____ PHONE _____

1. Baud 300_____ 300/1200_____ 1200_____ Other_____
2. Bell Standard_____ Touchtone Dial_____/Rotary Dial_____

   Direct Connect (Type)_____ Acoustic Coupled_____
3. Size: Depth _____ Width _____ Height _____ Weight _____
4. Appearance _____ Speaker _____
5. Half / Full Duplex _____ Auto Answer _____ Auto Dial _____
6. Select Voice / Data Transmission / Reception _____
7. Software Requirements_____
8. Special Cable(s) Required_____ Power Supply_____
9. Indicators/Alarms/Controls_____

   _____
10. Ease of Use_____
11. Ease of Installation/Adjustment_____
12. Operating Characteristics_____

    _____

    _____

13. Special Features_____

_____

_____

14. Documentation_____

_____

15. Tech Manuals_____

16. Warranty_____ Service_____ 800#_____

17. Special Requirements_____

18. Comments:

Date_____

INPUT DEVICE EVALUATION FORM

TYPE:_____

BRAND _____ MODEL _____ PRICE _____

Performance: Excellent Good Fair Poor Unacceptable

Documentation: Excellent Good Fair Poor Unacceptable

Ease of Use: Excellent Good Fair Poor Unacceptable

Usage: Commercial/Home: Excellent Good Fair Poor Unacceptable

MFG. _____ DEALER _____

ADDRESS _____ ADDRESS _____

CITY_____ ST_____ ZIP_____ CITY_____ ST_____ ZIP_____

PHONE _____ PHONE _____

1. Interface/Port_____ Cable:_____
2. Compatible With:_____
3. Use: Entertainment / Education / Business / Engineering / Other
4. Users: Children / Adults / All _____
5. Size: Depth _____ Width _____ Height _____ Weight _____
6. Appearance _____
7. Software Provided _____
8. Purpose _____

   _____
9. Indicators/Alarms/Controls _____

   _____
10. Ease of Use_____
11. Ease of Installation/Adjustment_____
12. Operating Characteristics_____

    _____

    _____

13. Special Features_____

_____

_____

14. Documentation_____

_____

15. Tech Manuals_____

16. Warranty_____ Service_____ 800#_____

17. Special Requirements _____

18. Comments:

Date_____

GENERIC PERIPHERAL EVALUATION FORM

DEVICE:_____

BRAND _____ MODEL _____ PRICE _____

Performance: Excellent Good Fair Poor Unacceptable

Documentation: Excellent Good Fair Poor Unacceptable

Ease of Use: Excellent Good Fair Poor Unacceptable

Usage: Commercial/Home: Excellent Good Fair Poor Unacceptable

MFG. _____ DEALER _____

ADDRESS _____ ADDRESS _____

CITY_____ ST_____ ZIP_____ CITY_____ ST_____ ZIP_____

PHONE _____ PHONE _____

1. Buffer; Power Protector/Back-up; Voice/Music Synthesizer; Other
2. Interface/Port_____ Cable_____
3. Compatible With:_____
4. Purpose: _____
5. Use: Entertainment / Education / Business / Engineering / Other
6. Users: Children / Adults / All _____
7. Size: Depth _____ Width _____ Height _____ Weight _____
8. Appearance _____
9. Software Provided _____
10. Indicators/Alarms/Controls _____

    _____
11. Ease of Use_____
12. Ease of Installation/Adjustment_____
13. Operating Characteristics_____

    _____

    _____

14. Special Features _____

_____

_____

15. Documentation _____

_____

16. Tech Manuals _____

17. Warranty _____ Service _____ 800# _____

18. Special Requirements _____

19. Comments:

Appendix B

LIST OF MANUFACTURERS BY TYPE OF PRODUCT

DOT-MATRIX PRINTERS

C. ITOH ELECTRONICS, INC.
5301 Beethoven Street
Los Angeles, CA 90066
(213) 306-6700

DATASOUTH COMPUTER CORP.
P.O. Box 240947
Charlotte, NC 28224
(704) 523-8500

EPSON AMERICA, INC.
3415 Kashiwa Street
Torrance, CA 90505
(213) 539-9140

INFORUNNER CORP.
1621 Stanford Street
Santa Monica, CA 90404
(213) 453-6688

INTERNATIONAL BUSINESS MACHINES CORP.
Building 227
P.O. Box 1328
Boca Raton, FL 33432
(800) 447-4700

MANNESMANN TALLY
8301 South 180th Street
Kent, WA 98032
(206) 251-5500

MICRO PERIPHERALS, INC.
4426 South Century Drive
Salt Lake City, UT 84107
(801) 263-3081

OKIDATA CORP.
111 Gaither Drive
Mt. Laurel, NJ 08054
(800) 654-3282

STAR MICRONICS, INC.
200 Park Avenue
Suite 2309
New York, NY 10166
(212) 986-6770

TEXAS INSTRUMENTS
Data Systems Group
Box 402430, H-646
Dallas, TX 75240
(800) 527-3500

LETTER-QUALITY PRINTERS

BROTHER INTERNATIONAL CORP.
8 Corporate Place
Piscataway, NJ 08854
(201) 981-0300

BYTEWRITER
125 Northview Road
Ithaca, NY 14850
(607) 272-1132

COMPUTERS INTERNATIONAL, INC.
3540 Wilshire Blvd.
Los Angeles, CA 90010
(213) 386-3111

DIABLO SYSTEMS, INC.
901 Page Road
P.O. Box 5030
Fremont, CA 94537
(415) 498-7000

JUKI OFFICE MACHINE CORP.
299 Market Street
Saddle Brook, NJ 07662
(201) 368-3666

NEC HOME ELECTRONICS (U.S.A.), INC.
Personal Computer Division
1401 Estes Avenue
Elk Grove Village, IL 60007
(312) 228-5900

VIVITAR COMPUTER PRODUCTS, INC.
2120 116th Avenue, NE
Bellevue, WA 98005
(206) 454-9250

PLOTTERS

ENTER COMPUTER, INC.
6867 Nancy Ridge Drive
San Diego, CA 92121
(619) 450-0601

HEWLETT-PACKARD CO.
1820 Embarcadero Road
Palo Alto, CA 94303
(415) 857-1501

PANASONIC INDUSTRIAL CO.
Computer Equipment Department
One Panasonic Way
Secaucus, NJ 07094
(201) 348-5337

MONOCHROME MONITORS

AMDEK CORP.
2201 Lively Boulevard
Elk Grove Village, IL 60007
(312) 364-1180

BMC USA, INC.
20610 Manhattan Place
Suite 112
Torrance, CA 90501
(213) 515-6005

COMREX INTERNATIONAL, INC.
3701 Skypark Drive
Suite 120
Torrance, CA 90505
(213) 373-0280

LEADING EDGE PRODUCTS, INC.
21 Highland Circle
Needham Heights, MA 02194
(617) 828-8150

PANASONIC INDUSTRIAL CO.
Computer Equipment Department
One Panasonic Way
Secaucus, NJ 07094
(201) 348-5337

COLOR MONITORS

AMDEK CORP.
2201 Lively Boulevard
Elk Grove Village, IL 60007
(312) 364-1180

BMC USA, INC.
20610 Manhattan Place
Suite 112
Torrance, CA 90501
(213) 515-6005

QUADRAM CORP.
4355 International Boulevard
Norcross, GA 30093
(404) 923-6666

SAKATA USA CORP.
651 Bonnie Lane
Elk Grove Village, IL 60007
(312) 593-3211

TAXAN CORP.
18005 Cortney Court
City of Industry, CA 91748
(818) 810-1291

TERMINALS

QUME CORP.
2350 Qume Drive
San Jose, CA 95131
(910) 338-0232

TELEVIDEO SYSTEMS, INC.
1170 Morse Avenue
Sunnyvale, CA 94086
(408) 745-7760

REMOTE TERMINALS/ KEYBOARDS

KEY TRONIC CORP.
P.O. Box 14687
Spokane, WA 99214
(509) 928-8000

MICROWRITER
520 5th Avenue
Penthouse
New York, NY 10036
(212) 288-8863

NOVATION, INC.
20409 Prairie Street
Box 2875
Chatsworth, CA 91311
(818) 996-5060

SONY CORP. OF AMERICA
Business Products Division
9 West 57th Street
New York, NY 10019
(212) 371-5800

MODEMS

ANCHOR AUTOMATION, INC.
6624 Valjean Avenue
Van Nuys, CA 91406
(818) 997-6493

COMDATA CORP.
7900 Nagle
Morton Grove, IL 60053
(312) 470-9600

HAYES MICROCOMPUTER
PRODUCTS, INC.
5923 Peachtree Industrial Blvd.
Norcross, GA 30092
(404) 449-8791

NOVATION, INC.
20409 Prairie Street
Box 2875
Chatsworth, CA 91311
(818) 996-5060

RACAL-VADIC
222 Caspian Drive
Sunnyvale, CA 94086
(408) 744-0810

TELTONE CORP.
10801 120th Avenue NE
P.O. Box 657
Kirkland, WA 98033
(206) 827-9626

MASS-STORAGE DEVICES

C. ITOH ELECTRONICS, INC.
5301 Beethoven Street
Los Angeles, CA 90066
(213) 306-6700

CORVUS SYSTEMS, INC.
2029 O'Toole Avenue
San Jose, CA 95131
(408) 946-7700

INDUS SYSTEMS
9304 Deering Avenue
Chatsworth, CA 91311
(800) 33-INDUS

NEC HOME ELECTRONICS
(U.S.A.), INC.
Personal Computer Division
1401 Estes Avenue
Elk Grove Village, IL 60007
(312) 228-5900

QUADRAM CORP.
4355 International Boulevard
Norcross, GA 30093
(404) 923-6666

QUME CORP.
2350 Qume Drive
San Jose, CA 95131
(910) 338-0232

RADIO SHACK
Tandy Corp.
1600 One Tandy Center
Ft. Worth, TX 76102
(817) 390-3111

RANA SYSTEMS
21300 Superior Street
Chatsworth, CA 91311
(800) 262-1224

TALLGRASS TECHNOLOGIES
11667 West 90th Street
P.O. Box 12047
Overland Park, KS 66212
(913) 492-6002

TANDON CORP.
20320 Prairie Street
Chatsworth, CA 91311
(818) 993-6644

CURSOR CONTROLLERS

CHALK BOARD, INC.
3772 Pleasantdale Road
Atlanta, GA 30340
(404) 447-6711

FUTUREHOUSE, INC.
P.O. Box 3470
Chapel Hill, NC 27514
(919) 967-0861

KOALA TECHNOLOGIES CORP.
3100 Patrick Henry Drive
Santa Clara, CA 95050
(408) 986-8866

LOGITECH, INC.
165 University Avenue
Palo Alto, CA 94301
(415) 364-3121

MOUSE SYSTEMS CORP.
2336H Walsh Avenue
Santa Clara, CA 95051
(408) 988-0211

POLYTEL COMPUTER PRODUCTS CORP.
2121 S. Columbia
Suite 550
Tulsa, OK 74114
(800) 331-4411

TECH SKETCH, INC.
26 Just Road
Fairfield, NJ 07006
(201) 227-7724

OPTICAL READERS

DATABAR CORP.
10202 Crosstown Circle
Eden Prairie, MN 55344
(612) 944-5700

MICRON TECHNOLOGY, INC.
2805 East Columbia Road
Boise, ID 83706
(208) 383-4000

VOICE/MUSIC SYNTHESIZERS

THE ALIEN GROUP
27 West 23rd Street
New York, NY 10010
(212) 741-1770

ROLAND CORP.
2401 Saybrook Avenue
Los Angeles, CA 90040
(213) 685-5141

STREET ELECTRONICS CORP.
1140 Mark Avenue
Carpinteria, CA 93013
(805) 684-4593

SYNTAURI CORP.
1670 South Amphlet Blvd.
Suite 116
San Mateo, CA 94402
(415) 574-3335

VOTRAX
1394 Rankin
Troy, MI 48083
(313) 588-2050

AUXILIARY SPEAKER/AMPLIFIER

CSP
P.O. Box 906015
Tulsa, OK 74112
(918) 836-3307

POWER PROTECTORS

BITS POWER SYSTEMS
11020 Audelia Road
Suite B114
Dallas, TX 75243
(800) 527-1378

CUESTA SYSTEMS, INC.
3440 Roberto Court
San Luis Obispo, CA 93401
(805) 541-5160

DYMARC INDUSTRIES, INC.
21 Governor's Circle
Baltimore, MD 21207
(800) 638-9098

ELECTRONIC PROTECTION DEVICES, INC.
P.O. Box 673
Waltham, MA 02254
(617) 891-6602

BUFFERS

CONSOLINK CORP.
1840 Industrial Circle
Longmont, CO 80501
(800) 525-6705

INTERACTIVE STRUCTURES, INC.
146 Montgomery Avenue
Bala Cynwyd, PA 19004
(215) 667-1713

JVB ELECTRONICS
1601 Fulton Avenue
Suite 1
Sacramento, CA 95825
(916) 483-0709

LIGO RESEARCH, INC.
396 E. 159th Street
Harvey, IL 60426
(312) 331-8797

PRACTICAL PERIPHERALS, INC.
31245 La Baya Drive
Westlake Village, CA 91362
(818) 991-8200

QUADRAM CORP.
4355 International Boulevard
Norcross, GA 30093
(404) 923-6666

ENVIRONMENTAL CONTROL

BSR (USA) LTD.
Route 303
Blauvelt, NY 10913
(914) 358-6060

Appendix C

LIST OF MANUFACTURERS IN ALPHABETICAL ORDER

THE ALIEN GROUP
27 West 23rd Street
New York, NY 10010
(212) 741-1770

AMDEK CORP.
2201 Lively Boulevard
Elk Grove Village, IL 60007
(312) 364-1180

ANCHOR AUTOMATION, INC.
6624 Valjean Avenue
Van Nuys, CA 91406
(818) 997-6493

BITS POWER SYSTEMS
11020 Audelia Road
Suite B114
Dallas, TX 75243
(800) 527-1378

BMC USA, INC.
20610 Manhattan Place
Suite 112
Torrance, CA 90501
(213) 515-6005

BROTHER INTERNATIONAL CORP.
8 Corporate Place
Piscataway, NJ 08854
(201) 981-0300

BSR (USA) LTD.
Route 303
Blauvelt, NY 10913
(914) 358-6068

BYTEWRITER
125 Northview Road
Ithaca, NY 14850
(607) 272-1132

CHALK BOARD, INC.
3772 Pleasantdale Road
Atlanta, GA 30340
(404) 447-6711

C. ITOH ELECTRONICS, INC.
5301 Beethoven Street
Los Angeles, CA 90066
(213) 306-6700

COMDATA CORP.
7900 Nagle
Morton Grove, IL 60053
(312) 470-9600

COMPUTERS INTERNATIONAL, INC.
3540 Wilshire Blvd.
Los Angeles, CA 90010
(213) 386-3111

COMREX INTERNATIONAL, INC.
3701 Skypark Drive
Suite 120
Torrance, CA 90505
(213) 373-0280

CONSOLINK CORP.
1840 Industrial Circle
Longmont, CO 80501
(800) 525-6705

CORVUS SYSTEMS, INC.
2029 O'Toole Avenue
San Jose, CA 95131
(408) 946-7700

CSP
P.O. Box 906015
Tulsa, OK 74112
(918) 836-3307

CUESTA SYSTEMS, INC.
3440 Roberto Court
San Luis Obispo, CA 93401
(805) 541-5160

DATABAR CORP.
10202 Crosstown Circle
Eden Prairie, MN 55344
(612) 944-5700

DATASOUTH COMPUTER CORP.
P.O. Box 240947
Charlotte, NC 28224
(704) 523-8500

DIABLO SYSTEMS, INC.
901 Page Road
P.O. Box 5030
Fremont, CA 94537
(415) 498-7000

DYMARC INDUSTRIES, INC.
21 Governor's Circle
Baltimore, MD 21207
(800) 638-9098

ELECTRONIC PROTECTION DEVICES, INC.
P.O. Box 673
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GLOSSARY

Alphanumeric Characters Alphabetic and numeric symbols; a set of characters which includes letters, numbers, and punctuation; the symbols found on a standard typewriter keyboard.

Antiglare Screen A transparent sheet of plastic or etched glass which is placed in front of a CRT screen to reduce reflections from surrounding light.

ASCII Abbreviation for American Standard Code for Information Interchange; a standard code for converting alphanumeric characters into binary code (series of ones and zeros) which the computer can understand.

Auto Answer The ability of a modem to detect a ringing telephone and to answer the call.

Auto Dial The ability of a modem to dial a telephone with input from the keyboard or from a stored telephone number; the ability of a modem to generate dial pulses that initiate a phone connection.

Auto Redial The ability of a modem to continue dialing a number until connection is made.

Back-Up *Verb:* To make extra copies of software and data on magnetic media (disks/tapes) or on paper; *Noun:* The extra copies of software and data used to prevent the loss of important information from accidental alteration or physical damage; also, an auxiliary source of power (battery) that prevents erasure of data in computer memory during an AC power brownout or blackout.

Ball A type of print head shaped like a ball and covered with raised alphanumeric characters. The ball strikes the ink-impregnated ribbon and prints a character on the paper.

Bar Code A printed bar and space representation of data; for example, the bar code printed on grocery items.

Bar-Code Reader An electronic device capable of sensing the bar-code pattern and conveying the coded information to a computer.

BASIC Beginner's All-purpose Symbolic Instruction Code; a computer language that is very popular for writing programs for personal computers.

Baud Rate The rate at which data is transmitted over wires and telecommunication lines, measured in bits per second. Typical baud rates for modems are 300 and 1200 bits per second or 30 and 120 characters per second.

Bidirectional The ability of a printer to print from left to right and right to left, which permits more rapid printing since the print head doesn't have to return to the left margin to print the next line.

Bit The smallest piece of information in a binary notation system; a one or zero in a binary character (binary digit).

Bits Per Second (bps) See baud rate.

Blackout The total loss of AC utility power which results in the loss of information from computer memory and which may damage sensitive computer circuits.

Brownout The reduction of AC utility power from three to eight percent to conserve electricity during high-demand periods; may result in loss of information from computer memory and damage to sensitive computer circuits and components.

Buffer A memory device used to store computer output and send it to a modem or printer (auxiliary device) at a rate that the peripheral can accept and process the information. This relieves the computer from monitoring slower operations such as printing.

Byte A single character or alphanumeric symbol represented by binary ones and zeros; the smallest addressable unit of computer memory; an eight-bit computer uses eight bits (ones and zeros) to form one byte.

Cable A wire or group of wires used to transmit electricity or electrical signals; for example, a power cable, serial cable, parallel cable, or joystick cable.

Cache Disk (RAM Disk) A block of computer memory (RAM) attached to the computer in such a way that the computer perceives it as an auxiliary disk drive. Since the RAM disk is much faster than a floppy disk, this allows the computer to retrieve and save information at higher speeds. Cache disks are usually volatile and will lose their information when power is turned off.

Carrier Detect The ability of a modem to sense that it has made a successful connection with another modem and computer.

Cartridge Ribbon A sealed plastic case that contains a printer ribbon and reels; may be snapped into the printer mechanism without having to handle the ribbon itself.

Cassette Tape Magnetic tape housed in a sealed plastic case; used to store programs (instructions) and data for computer use.

Character See alphanumeric character.

Characters Per Inch (cpi) A measure of print pitch; the number of characters that a printer prints in one inch.

Chip An electronic component that contains as many as 30,000 electronic parts, for example, a memory chip or microprocessor.

Clock A real-time clock that lets the computer keep track of the actual time of day.

Communication The ability of one device to send and or receive signals and data to and from another device; for example, a computer can communicate with a printer; a modem can communicate over common telephone lines with another modem, and a keyboard can communicate with a computer.

Communication, Duplex The method(s) modems use to communicate with each other: half-duplex communication means that each modem may talk one at a time (like ham radio); full-duplex communication means that the modems may talk to each other simultaneously.

Communication Rate See baud.

Compatible The ability of one device to work with another; for example, a printer may be compatible with a computer. Also, the ability of a program or data file to be used with a computer; for example, a program that is IBM compatible will work with most computers that are IBM compatible.

Computer Specific Any device that can only be used with one computer; for example, a plug-in expansion board for an Apple computer.

Configure To arrange programs (instructions) and/or devices so that they will work together; for example, to configure a printer (set DIP switches) so that it will communicate with a particular computer.

Continuous Duty-Cycle Operating a piece of equipment 24 hours a day.

Controls (Monitor) Adjustments used to vary brightness, contrast, horizontal hold, vertical hold, focus, tint, color, and audio volume. Similar to the controls on a television set.

Control Code A specific signal that commands the computer to do something, activated by pressing the CTRL (CONTROL) key on the keyboard, followed by an alphanumeric character. When the computer senses the CTRL code it interprets the following character as a command rather than as alphanumeric input. Control codes may also be signaled by pressing ALT (ALTERNATE), ESC (ESCAPE), and FN (FUNCTION) keys together with other keys. This allows a standard keyboard to send two to three times the amount of information to the computer.

Correspondence-Quality Print A description of dot-matrix, double-strike or multiple-strike print which resembles letter or typewriter quality print.

CPU (Central Processing Unit) The part of a computer system that controls the interpretation and execution of instructions.

Cursor A mark on the computer screen (blinking underline, bright box, cross-hair, etc.) that signifies where the next keyboard entry will be recorded. Cursor-sensing terminals "know" that the cursor position (coordinates) may indicate the type of information defined by row and column; for example, row 10, column 30 may indicate the year-to-date sales. Entering a number into that location will tell the computer more than just the absolute figures typed.

Daisy Wheel A print head that looks like a wheel with spokes or a daisy with petals. At the end of each spoke is a raised alphanumeric character. As the wheel spins, a hammer strikes the petal which, in turn, strikes an ink-impregnated ribbon and forms a character on paper. Daisy wheel printers produce typewriter-quality print.

Data Processing Quality Print Dot-matrix print formed in a single pass of the print head; a print mode that produces characters with a distinct dot pattern. Print quality is sacrificed to gain speed of up to 200 characters per second.

Decibel (dB) A measure of sound level. One decibel is approximately the smallest sound that the ear can hear. The loudest acceptable sound level for a printer in an office is 60 to 70 decibels.

Default Operating assumptions made at the time a device is turned on or a program is loaded into the computer; for example, a printer may default to single space and a word processor may default to a format of 66 lines per page.

Density The amount of data per unit of space that can be stored on a magnetic storage medium such as tape or floppy disk. See also, disk.

Digital Camera A camera that uses an optic RAM chip to sense light and dark fields. Binary (digital) information about light and dark areas is communicated to the computer, which is then able to construct an image to display on the screen and on the printer.

Digital-to-Analog A device, an acoustic modem or a speech synthesizer, for example, capable of converting digital information into analog signals such as sound.

Digitizer A tablet (grid) of switches or a position-sensing device that converts movement into (digital) information that the computer can use, for example, a digital tablet, mouse, or a light pen.

DIP (Dual-in-Line Pin) Switches Tiny rocker switches that allow the user to configure the computer and peripheral devices so that they can communicate with one another; they are used, for example, to set baud rate and communication protocol (rules).

Direct Access The ability of a disk drive to move the read/write head directly to the disk track where data is stored and to sense/write that data within one rotation of the disk.

Disk, Floppy A flat, circular plate of Mylar plastic with a ferrous-oxide coating on which data can be magnetically stored and from which information can be sensed. Common sizes for personal computers are 3¼ inch, 5¼ inch, and 8 inch. The disk is housed in a protective cardboard envelope with cut-out slots that allow the read/write heads to access the magnetic surface. Since the disk drive read/write head rests on the disk surface (except for the Sony 3¼-inch drive), the disk will eventually wear out and may be damaged by contaminants such as dust and cigarette smoke. Disks are single-sided or double-sided, and have single density or double density.

Disk Drive An electromechanical device that holds and spins a floppy disk and houses the positioner which moves the read/write head in and out to the track requested by the computer.

Documentation The written manuals and instructions that the user reads to find out how to operate a device or program.

DOS (Disk Operating System) The instructions used by the computer to communicate with the disk drive. DOS allows the computer to save and retrieve information, create, delete, and erase files, and do a number of other operations. Computers not using an auxiliary disk drive for storage do not need disk operating systems.

Dots Per Inch The number of dots a graphics printer or plotter can produce in one linear inch.

Double Strike A printing mode that allows the print head to pass over the same print line twice. By moving the platen slightly or by offsetting the print head position horizontally, the matrix printer can produce more solid characters, called correspondence, bold, or enhanced print.

Down Load To bring a program or file into a computer from another computer, as with a modem.

Dump To send a file or program to a printer or to auxiliary storage, such as a disk.

Envelope Feeder An electromechanical device used to insert envelopes one at a time into a printer.

Environmental Controller A device that upon command sends signals to controlling modules that dim lights and turn electrical devices on and off. When connected to and controlled by a computer, the user can "program" sequences of events over a prolonged period of time.

Fan-Fold Paper Computer printer paper connected end-to-end with perforations. Used for continuous printing operations.

FIFO (Buffer) A buffer (memory device) that works on a First-In-First-Out basis; that is, the first information that the buffer receives is the first information sent to the printer.

Filter (AC) An electronic device that blocks the passage of unwanted voltage spikes and electromagnetic interference.

Firing Button A control switch on a joystick or game paddle.

Font The characteristics of print such as size and style, for example, an Old English or an italic font.

Foot Print The amount of desktop space that a device occupies.

Foreground The brighter characters displayed on a CRT screen when two levels of intensity are displayed.

Form Feed A printer control that allows the user to move the paper through the mechanism one full sheet at a time.

Fuse A circuit protection device that melts when excessive current passes through it.

Game Paddle An electromechanical input device which works with variable resistance. The computer converts the position of the paddle knob into numeric information that conveys position and speed information for cursor control.

Hacker A computer enthusiast who isn't afraid of opening a computer case or modifying the circuits. One who is usually able to write and modify programs as well as troubleshoot most computer difficulties.

Half Intensity The background or fainter characters on a CRT display when two levels of brightness are used.

Handshaking Communication rules and operations that enable two devices to talk to one another—may include passwords used to protect programs and files from intruders.

Hardware Equipment, devices, and cables used in a computer system; contrast with software.

Indicator (LED) A small light that indicates whether a certain operation or condition exists; for example, an LED that indicates that the keyboard CAPS LOCK key is on, an LED that indicates that a printer is on line, and an LED that indicates that a disk drive is accessing the disk.

Interface The circuit which forms the communication link between the computer and the auxiliary device. Includes RS-232C serial, Centronics parallel, RS-449 serial, S-100, and serial TTL. A serial interface allows bits (binary ones and zeros) of data to travel single file (bit-by-bit) down one wire to the device, to a modem, for example. A parallel interface data transmission mode sends data through eight wires in a byte-by-byte fashion, for example, to a printer.

Joystick An electromechanical input device that communicates position information on the x-axis and y-axis. Rising from a small box, the stick may be moved in any direction to communicate up, down, right, and left, and the 45-degree angles in between (northeast, southwest, etc.). The position of the joystick controls the cursor movement on the CRT screen.

Keyboard An electromechanical input device used to enter alphanumeric information. The standard personal computer keyboard has a

QWERTY layout, named for the order of the keys in the upper left row. The Dvorak keyboard is arranged so that the most frequently used keys appear on home row. Programmable keyboards allow the user to rearrange and assign special meanings to some or all of the keys. The HASCI keyboard has many keys that correspond to common computer operations such as save file to disk, load file from disk, etc. Sealed, membrane keyboards protect the electronic switches from hostile environments. Keyboards for the handicapped provide locking keys for one-handed operation of control keys. Some keyboards are integral to the computer or terminal housing. Detachable keyboards connect to the computer with a wire or communicate with infrared (remote) signals, the IBM PCjr, for example.

Keypad, Numeric A ten-key input device that provides efficient input of numeric data. May be integral to the standard keyboard or may be in a separate box.

Lamp See LED.

LED (Light Emitting Diode) A small light source that indicates the status of a piece of computer equipment; for example, on/off line, power on/off, paper out.

Letter-Quality Print The print mode that is equivalent to typewriter quality.

Light Pen A CRT screen coordinate sensor used to control cursor movement. It may be used to select items from menus and to draw computer graphics.

Liquid Crystal Display (LCD) A display technology that requires little power. The thin, compact structure lends itself well to portable computers.

Mean Time Between Failures (MTBF) A performance rating that indicates how frequently a piece of equipment may need service.

Memory The ability of a computer or other device to retain information for future use. Volatile memory is erased when power is removed: RAM. Nonvolatile memory remains intact when power is removed: ROM. See also, mass storage.

Menu A list of options which allows the user to direct the operation of a computer. Menu-driven software is said to be more user friendly, since the user only has to make choices instead of having to remember complex command sequences.

Microcomputer A general-purpose digital computer which is controlled by programs, has internal memory, communicates with input and output devices, and contains one or more small process chips (CPU). See also, microprocessor.

Microprocessor The control and processing part of a small computer which handles both arithmetic and logic operations. See also, microcomputer.

Modem (Modular/Demodulator) An electronic device capable of converting digital information (discrete on/off signals) into analog signals (variable waveforms such as sound) and vice versa. Used to convert (modulate) computer information into a form transmittable across common telephone lines to a receiving modem that converts (demodulates) the analog signals into digital information that the receiving computer can understand.

Monitor A display device that resembles a television receiver, used to display computer input and output. Monochrome monitors are usually black and white, black and green, or black and amber. Composite color monitors display good color graphics and up to 40 columns of text. RGB color monitors are capable of producing high resolution color graphics and 80 columns of text.

Mouse A cursor control and computer input device. A mechanical mouse rolls on a ball or on wheels. The motion of the mouse is converted into information that controls the position and movement of the cursor. An optical mouse moves across a grid-patterned pad, and the reflections of the light convey position and movement information to the computer. Buttons on the mouse allow the user to select menu items, demark text in a word processor, and draw graphics.

Music Synthesizer An electromechanical device that enables a computer user to compose, edit, and listen to computer-generated music and sound effects.

Near Letter-Quality Print (NLQ) A printing quality that isn't quite typewriter quality, but is very close.

NIOSH National Institute for Occupational Safety and Health.

Noise Electromagnetic interference: the static created on a television set by a blender, for example.

Nonglare Screen See antiglare screen.

On/Off Line Being in communication with a computer: For example, a printer is on line when it is ready to receive data to print. It is off line when it is turned off, disabled by the out-of-paper sensor, or disconnected from the printer port.

Optical Reader A sensing device that can read characters, bar code, and other optical images: a bar-code reader or digital camera, for example.

Paper Feed The method for moving paper through a printer mechanism. Friction feed resembles the traditional typewriter that moves paper between a rubber platen and the frame. Tractor and pin feed printers

have small sprockets that fit into a series of holes running alongside the printer paper (similar to a 35 mm camera moving film past the shutter). Tractors and pin feed mechanisms may adjust to different widths to accommodate narrower forms and mailing labels. The accuracy of registration is much better with the mechanisms that prevent paper slippage.

Pixel The smallest spot of light produced on a CRT screen.

Plasma Display See liquid crystal display.

Platen The roller that moves paper through a friction feed printer.

Plotter An electromechanical output device that allows the computer to draw finely detailed graphics such as architectural drawings.

Port See interface.

Port, Cassette Tape A special input/output interface that allows the transfer of information between a cassette tape player/recorder and personal computer.

Port, Game A special input interface to which joysticks, game paddles, and digital tablets may be connected to convey information to the computer.

Port, Parallel See interface.

Port, Serial See interface.

Power Back-Up See power supply, auxiliary.

Power Protection A device that protects sensitive computer equipment from electromagnetic interference and voltage spikes.

Power Supply, Auxiliary A stand-by battery power source that automatically supports computer operation in the case of AC power brownout or blackout.

Power Supply, Wall Transformer An external power supply that plugs into the wall and transforms AC current into the proper level of DC current, frequently used to power buffers and modems.

Power Supply, Uninterruptible See power supply, auxiliary.

Print Head That part of the printer mechanism that moves across the paper to form character images. Impact printers use hammer(s) to strike the ink-impregnated ribbon; for example, daisy wheel printers and impact dot-matrix printers. Some print heads heat up (thermal), pass electricity through needles (electrostatic), or squirt ink (ink jet) to form images.

Printer An electromechanical device that produces printed copy of computer output. A matrix printer forms characters from small dots; for example, impact, thermal, and electrostatic dot-matrix printers. A daisy wheel, thimble, or ball printer creates fully formed (typewriter quality) images. An ink jet printer squirts tiny jets of ink to form letter-quality print. See also, paper feed and print head.

Program Computer instructions that tell the computer what to do and when to do it. Applications programs perform specific tasks such as printing paychecks and word processing. See also, disk operating system.

Proportional Spacing The ability of a printer to allocate more space for wider letters such as "w" and less space for thin letters such as "i".

Protocol See handshaking.

RAM (Random-Access Memory) The computer's internal working memory where program instructions and data are stored. Peripheral devices such as printers and buffers may also contain RAM, which is used to store data while the printer is busy. Since RAM is volatile, the stored data is erased when power is removed. See also, ROM.

RCA Phono Plug A standard jack used to connect audio and composite video computer output cables to peripherals.

Read To sense or detect; for example, to read information from a floppy disk or cassette tape.

Resolution The measure of the smallest possible increment of change in position; for example, the resolution of a CRT screen or the resolution of a plotter. The higher the resolution, the more detailed and clear the image.

Reverse Video The ability of a terminal or computer to produce on a CRT screen black characters on a bright background.

Ribbon The ink-impregnated cloth or carbon-coated film struck by the print head to produce an image on paper.

ROM (Read-Only Memory) Computer memory that contains unalterable instructions basic to the computer's functional integrity. ROM cannot be erased. ROM cartridges are used by some computers for storing applications programs. Some peripherals use ROM to store default instructions such as print style; for example, font. See also, RAM.

Schematic (Electronic) A symbolic drawing of an electronic circuit showing the parts, their electronic values, and interconnections.

Self-Test The ability of a device to test its own operations even though disconnected from the computer; for example, a printer self-test.

Short-Line-Logic Seeking The ability of the printer to proceed to the next line of print once all the characters in a line are printed. This feature improves printing speed.

Signal, Out-Of-Paper A buzzer or light that warns the user that the printer has run out of paper. This signal should also turn the printer off until the user attends to the problem.

Single-Sheet Feed The ability of a printer to stop printing at the end of each page and allowing the user to insert a single piece of paper; for example, company letterhead.

Software See program and disk operating system.

Streaming Tape A high-capacity, fast, auxiliary storage device used to back up data on a hard disk.

Storage Auxiliary memory that is less expensive than internal computer

memory. Used to store large programs and large amounts of data for computer use; for example, floppy disks, hard disks, and cassette tape. See also, memory.

Stringy Floppy A continuous loop cassette tape that provides rapid access to programs and data.

Tape See cassette tape.

Telecommunications The science of communication by electric, electronic, or electromagnetic means; for example, communicating computer data over common telephone lines with the use of a modem.

Terminal An input/output device used to interface the computer with the computer operator. It usually includes a keyboard for computer input and a CRT screen for observing computer output and processes. See also, monitor and keyboard.

Throughput The rate at which a printer can produce printed copy. A more accurate rating than characters per second or lines per minute.

Trackball An electromechanical input device that conveys position and speed information for cursor control. By rolling the ball housed in a box, the user conveys cursor control information for playing games.

True Descenders A printer or terminal capable of producing true descenders can display the tails of the letters "y", "j", and "g" below the base line. This improves readability.

Unidirectional A print head movement that allows the printer to print in one direction only; for example, from left to right. Contrast with bidirectional.

Upload Sending data or programs to a computer; for example, to upload a program to a computer.

User's Manual The instructions that tell the user how to operate a computer, program, or peripheral device.

Voice Recognition The ability of a computer to sense human voice commands and utilize them for computer input and control. Speaker-dependent voice recognition systems require that the user train the computer to recognize a person's voice pattern.

Voice Synthesizer A device that converts digital computer output into audio signals that resemble the human voice.

Write To transmit computer output (information) to auxiliary storage media such as floppy disk and cassette tape.

If you think choosing the right computer is hard, have you tried buying the peripherals—the disk drives, modems, monitors, add-on boards and other devices that don't come with the basic computer but are often essential to working productively on it? For every one computer there may be dozens of different kinds of devices to buy, and for each device dozens of manufacturers. With this book, you'll be able to solve your expansion problems. In an easy-to-follow format, experienced computer consultant Linda Christie covers all the important peripherals for today's and tomorrow's computing needs, from printers, modems and auxiliary memory boards to light pens and plotters. Each chapter contains a generic product overview with buying advice, and specific product reviews that include user tips, performance ratings and system requirements. There is also a directory of manufacturers and a glossary of terms. Most importantly, *every* device in this book has been thoroughly tested by the author. With *The Simon & Schuster Guide to Computer Peripherals*, you can expand your system safely, economically and confidently.

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